REG10J0001-0100

Renesas Starter Kit for H8SX1582

User's Manual

RENESAS SINGLE-CHIP MICROCOMPUTER
H8SX FAMILY

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Chapter 1. Preface

Cautions

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Glossary

BRR	Baud Rate Register
ERR	Error Rate
HMON	Embedded Monitor
RTE	Renesas Technology Europe Ltd.
RSK	Renesas Starter Kit
RSO	Renesas Solutions Corp.

Chapter 2.Purpose

This RSK is an evaluation tool for Renesas microcontrollers.

Features include:

- Renesas Microcontroller Programming.
- User Code Debugging.
- User Circuitry such as switches, LEDs and potentiometer(s).
- Sample Application.
- Sample peripheral device initialisation code.

The CPU board contains all the circuitry required for microcontroller operation.

This manual describes the technical details of the RSK hardware. The Quick Start Guide and Tutorial Manual provide details of the software installation and debugging environment.

Chapter 3.Power Supply

3.1.Requirements

This CPU board operates from a 5V power supply.

A diode provides reverse polarity protection only if a current limiting power supply is used.

All CPU boards are supplied with an E8 debugger. This product is able to power the CPU board with up to 300mA. When the CPU board is connected to another system that system should supply power to the CPU board.

All CPU boards have an optional centre positive supply connector using a 2.0mm barrel power jack.

Warning

The CPU board is neither under not over voltage protected. Use a centre positive supply for this board.

3.2.Power – Up Behaviour

When the RSK is purchased the CPU board has the 'Release' or stand alone code from the example tutorial code pre-programmed into the Renesas microcontroller. On powering up the board the user LEDs will start to flash. Switch 2 will cause the LEDs to flash at a rate controlled by the potentiometer.

Chapter 4.Board Layout

4.1.Component Layout

The following diagram shows top layer component layout of the board.

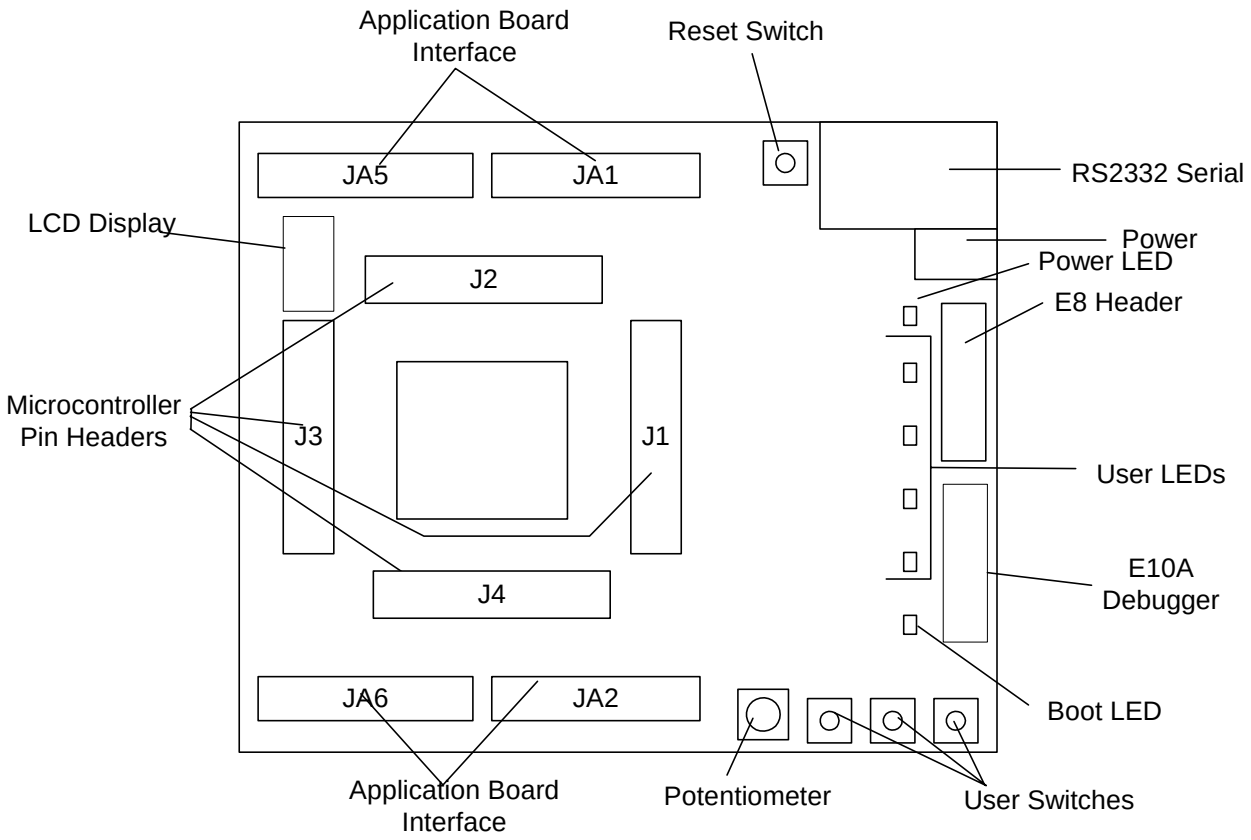


Figure 4-1: Board Layout

4.2.Board Dimensions

The following diagram gives the board dimensions and connector positions. All through hole connectors are on a common 0.1" grid for easy interfacing.

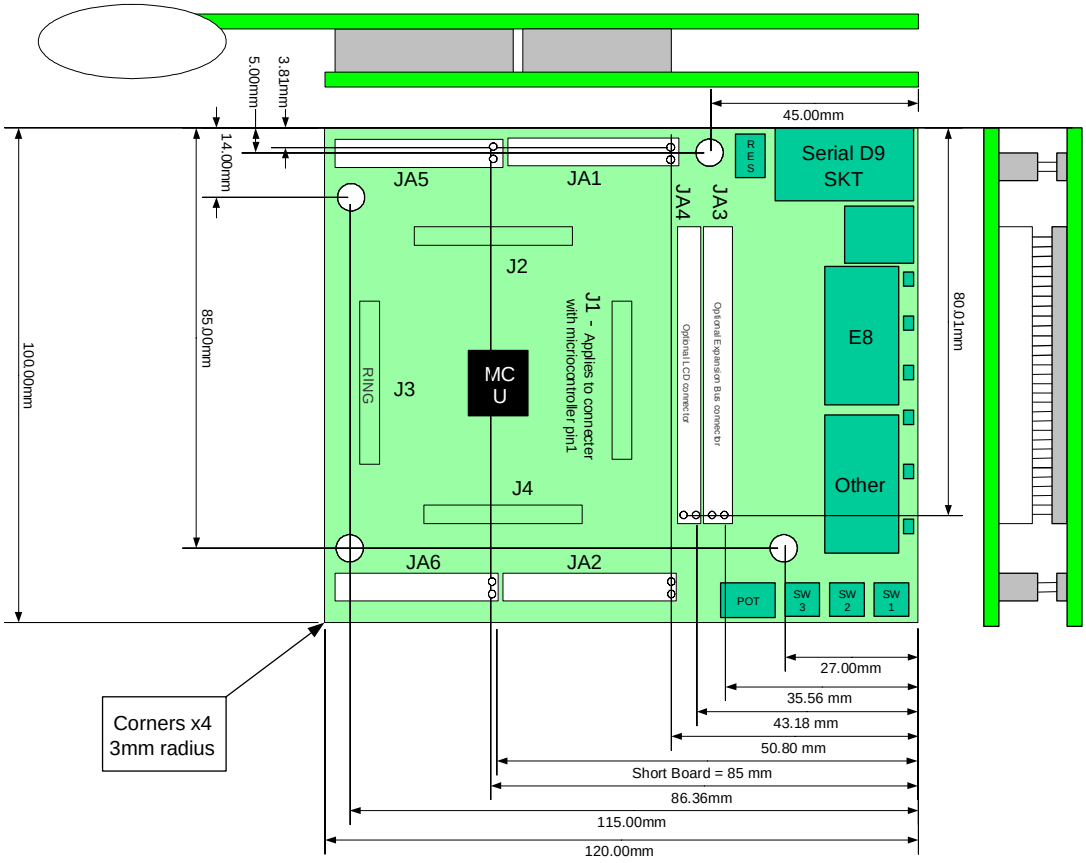


Figure 4-2 : Board Dimensions

Chapter 5.Block Diagram

Figure 5-1 shows the CPU board components and their connectivity.

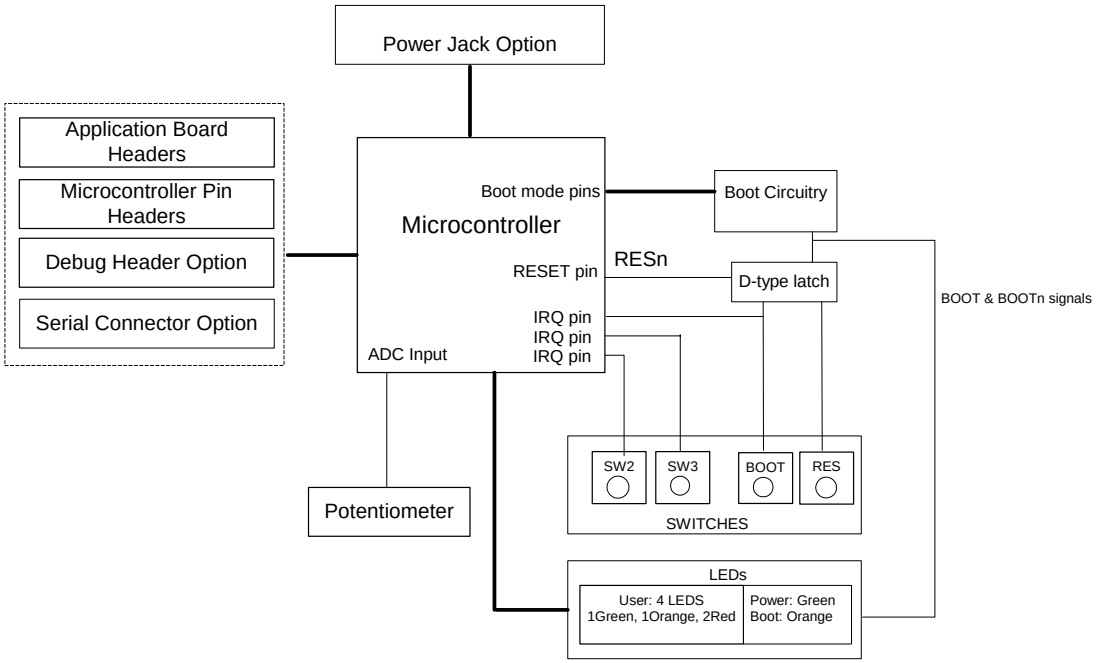


Figure 5-1: Block Diagram

Figure 5-2 shows the connections to the RSK.

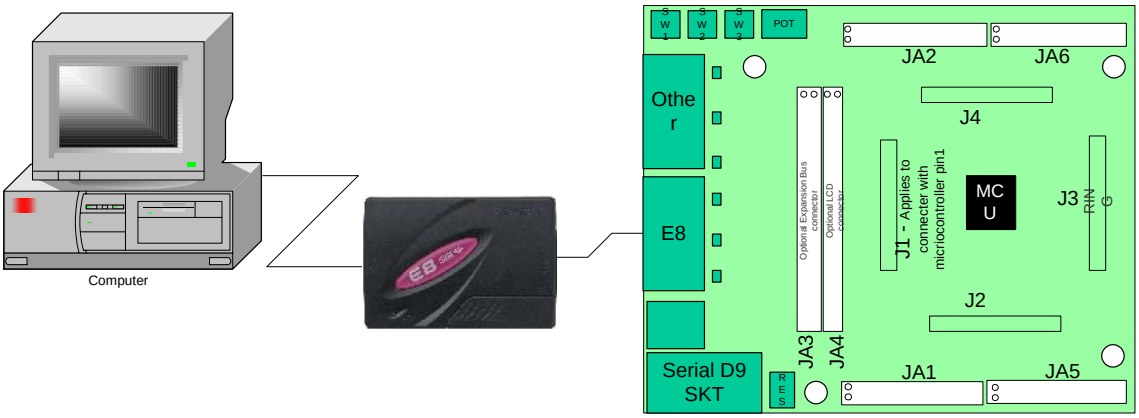


Figure 5-2 : RSK Connctions

Chapter 6.User Circuitry

6.1.Switches

There are four switches located on the CPU board. The function of each switch and its connection are shown in Table 6-1.

Switch	Function	Microcontroller
RES	When pressed; the CPU board microcontroller is reset.	RESn
SW1/BOOT*	Connects to an IRQ input for user controls. The switch is also used in conjunction with the RES switch to place the device in BOOT mode when not using the E8 debugger.	IRQ8-A, Pin 58 (Port 2, pin 0)
SW2*	Connects to an IRQ line for user controls.	IRQ9-A , Pin59 (Port 2, pin 1)
SW3*	Connects to the ADC trigger input. Option link allows connection to IRQ line. The option is a pair of 0R links.	ADTRG, Pin 57 (Port 1, pin 7) *OR* IRQ10-A, Pin 60 (Port 2, pin 2)

Table 6-1: Switch Functions

*Refer to schematic for detailed connectivity information.

6.2.LEDs

There are six LEDs on the CPU board. The green 'POWER' LED lights when the board is powered. The orange BOOT LED indicates the device is in BOOT mode when lit. The four user LEDs are connected to an IO port and will light when their corresponding port pin is set low.

Table 6-2, below, shows the LED pin references and their corresponding microcontroller port pin connections.

LED Reference (As shown on silkscreen)	Microcontroller Port Pin function	Microcontroller Pin Number	Polarity
LED0	Port I 0	113	Active Low
LED1	Port I 1	115	Active Low
LED2	Port I 2	118	Active Low
LED3	Port I 3	12	Active Low

Table 6-2:LED Port

6.3.Potentiometer

A single turn potentiometer is connected to AN0 of the microcontroller. This may be used to vary the input analog voltage value to this pin between AVCC and Ground.

6.4.Serial port

The microcontroller programming serial port (SCI4) is connected to the E8 connector. This serial port can optionally be connected to the RS232 transceiver by moving option resistors and fitting the D connector in position J9. The connections to be moved are listed in the following table.

Description	Function	Fit For E8	Remove for E8	Fit for RS232	Remove for RS232
SCI4 Tx	Programming Serial Port	R15	R14	R14	R15
SCI4 Rx	Programming Serial Port	R12	R13	R13	R12
SCI4 Clk	Programming Serial Port	R10	NA	NA	NA

Table 6-3 - Serial Option Links

The board is designed to accept a straight through RS232 cable. A secondary microcontroller serial port is available and connected to the application headers. Please refer to the schematic diagram for more details on the available connections.

The serial baud rates supported by this CPU board are shown below. Note: these values are calculated from the frequency value of the main oscillating source fitted by default on this CPU board.

6MHz x 4 = 24MHz	Asynchronous Serial Baud Rate Evaluation											
N	0			1			2			3		
	BRR	Rate	ERR	BRR	Rate	ERR	BRR	Rate	ERR	BRR	Rate	ERR
110										106	110	-0.44
300							155	300	0.16	38	300	0.16
1200				155	1202	0.16	38	1202	0.16	9	1172	-2.34
2400				77	2404	0.16	19	2344	-2.34	4	2344	-2.34
4800	155	4808	0.16	38	4808	0.16	9	4688	-2.34	1	5859	22.07
9600	77	9615	0.16	19	9375	-2.34	4	9375	-2.34	0	11719	22.07
19200	38	19231	0.16	9	18750	-2.34	1	23438	22.07			
38400	19	37500	-2.34	4	37500	-2.34	0	46875	22.07			
57600	12	57692	0.16	2	62500	8.51						
115200	6	107143	-6.99	1	93750	-18.62						
230400	2	250000	8.51									
250000	2	250000	0.00									
375000	1	375000	0.00									
750000	0	750000	0.00									

Table 6-4 : BRR Settings

6.5.LCD Module

A LCD module can be connected to the connector J13. Any module that conforms to the pin connections and has a KS0066u compatible controller can be used with the tutorial code. The LCD module uses a 4bit interface to reduce the pin allocation. No contrast control is provided; this must be set on the display module.

Table 6-5 shows the pin allocation and signal names used on this connector.

The module supplied with the CPU board only supports 5V operation.

J13					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	Ground	-	2	5V Only	-
3	No Connection	-	4	DLCDRS	51
5	R/W (Wired to Write only)	-	6	DLCDE	55
7	No Connection	-	8	No connection	-
9	No Connection	-	10		-
11	DLCD4	68	12	DLCD5	67
13	DLCD6	66	14	DLCD7	61

Table 6-5 LCD Module Connections

6.6.Option Links

Table 6-6 below describes the function of the option links contained on this CPU board. The default configuration is indicated by **BOLD** text.

Option Link Settings				
Reference	Function	Fitted	Alternative (Removed)	Related To
R10	Programming Serial Port	*Connects SCK to E8*	SCK disconnected from E8	R12, R13, R14, R15
R12	Programming Serial Port	**Connects E8 to Programming Serial port.**	MUST be removed if R13 fitted.	R13
R15	Programming Serial Port	**Connects E8 to Programming Serial port.**	Should be removed if R14 fitted.	R14
R13	Programming Serial Port	Connects RS232 port to Programming SCI port	**MUST be removed if R12 fitted.**	R12
R14	Programming Serial Port	Connects RS232 port to Programming SCI port	**Should be removed if R15 fitted.**	R15
R62	RS232 Driver	Enables RS232 Serial Transceiver	**MUST be removed if R18 Fitted**	R18, R13, R14
R18	RS232 Driver	**Disables RS232 Serial Transceiver**	MUST be removed if R62 Fitted	R62, R13, R14
R36	Serial Connector	Connects Alternate serial to D connector	**Disconnects Alternate serial from D connector.**	R31
R31	Serial Connector	Connects Alternate serial to D connector	**Disconnects Alternate serial from D connector.**	R36
R35	Alternate Serial	Connects Alternate Serial to RS232 Transceiver	**Should be removed if External serial device.**	R37, JA6
R37	Alternate Serial	Connects Alternate Serial to RS232 Transceiver	**MUST be removed if External serial device.**	R35, JA6
R53	External Oscillator	Connects External Ring header pins to Microcontroller	**Disconnects sensitive microcontroller signals from external pins.**	R55
R55	External Oscillator	Connects External Ring header pins to Microcontroller	**Disconnects sensitive microcontroller signals from external pins.**	R53
R46	Power	**Supply to microcontroller**	Fit Low ohm resistor to measure current	R63
R63	Analogue Power	**Connects 5V supply to Analogue supply**	Analogue supply MUST be provided from external interface pins.	JA1
R58	SW3	**Connects SW3 to Analogue Trigger input**	Disconnected	R59
R59	SW3	Connects SW3 to IRQ input	**Disconnected**	R58

Table 6-7: 2-Pin jumpers

6.7.Oscillator Sources

A crystal oscillator is fitted on the CPU board and used to supply the main clock input to the Renesas microcontroller. Table 6-8 details the oscillators that are fitted and alternative footprints provided on this CPU board:

Component					
		Value : Package	Manufacturer		
Crystal (X1)	Fitted	6MHz : HC/49U	Approved	See www.renesas.com for details	
			CPU board	Magna Frequency Components	X6M0GCBE494SM*
				C-Mac	LFXTAL017159

Table 6-8: Oscillators / Resonators

Warning: When replacing the default oscillator with that of another frequency, the debugging monitor will not function unless the following are corrected:

- FDT programming kernels supplied are rebuilt for the new frequency
- The supplied HMON debugging monitor is updated for baud rate register settings.

The user is responsible for code written to support operating speeds other than the default. See the HMON User Manual for details of making the appropriate modifications in the code to accommodate different operating frequencies.

6.8.Reset Circuit

The CPU Board includes a simple latch circuit that links the mode selection and reset circuit. This provides an easy method for swapping the device between Boot Mode, User Boot Mode and User mode. This circuit is not required on customers boards as it is intended for providing easy evaluation of the operating modes of the device on the RSK. Please refer to the hardware manual for more information on the requirements of the reset circuit.

The reset circuit operates by latching the state of the boot switch on pressing the reset button. This control is subsequently used to modify the mode pin states as required.

The mode pins should change state only while the reset signal is active to avoid possible device damage.

The reset is held in the active state for a fixed period by a pair of resistors and a capacitor. Please check the reset requirements carefully to ensure the reset circuit on the user's board meets all the reset timing requirements.

Chapter 7.Modes

The CPU board supports User mode, Boot mode and User Boot mode. User mode may be used to run and debug user code, while Boot mode may only be used to program the Renesas microcontroller with program code. User Boot mode can only be used to program the User Mat (the main area of 768Kbytes of Flash ROM on the device). It does not support programming of the user boot area. User Boot mode is used to run a user supplied boot-loader program stored in the user boot MAT (the smaller area, 8Kbytes, of Flash ROM). To program the user boot MAT, the device must be in Boot mode. Further details of programming the MATs are available in the H8SX/1582 hardware manual.

When using the E8 debugger supplied with the RSK the mode transitions are executed automatically. The CPU board provides the capability of changing between User and Boot / User Boot modes using a simple latch circuit. This is only to provide a simple mode control on this board when the E8 is not in use.

To manually enter boot mode, press and hold the SW1/BOOT. The mode pins are held in their boot states while reset is pressed and released. Release the boot button. The BOOT LED will be illuminated to indicate that the microcontroller is in boot mode.

More information on the operating modes can be found in the device hardware manual.

7.1.FDT Settings

In the following sections the tables identify the FDT settings required to connect to the board using the E8Direct debugger interface. The 'A' interface is inverted on the RSK board. This is to ensure the board can function in a known state when the E8 is connected but not powered. The E8 Debugger contains the following 'pull' resistors.

E8 Pin	Resistor
A	Pull Down (100k)
B	Pull Up (100k)
C	Pull Down (100k)
D	Pull Up (100k)

Table 7-1: E8 Mode Pin drives

7.1.1.Boot mode

The boot mode settings for this CPU board are shown in Table 7-2 below:

MD1	MD0	LSI State after Reset End	FDT Settings	
			A	B
1	0	Boot Mode	0	0

Table 7-2: Mode pin settings

The following picture shows these settings made in the E8Direct configuration dialog from HEW.

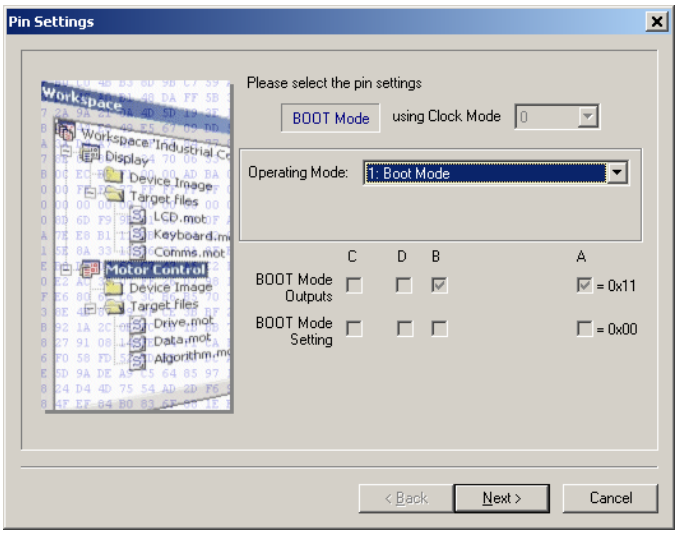


Figure 7-1: Boot Mode FDT configuration

7.1.2.User Boot mode

A Note on Mats:

The H8SX/1582 possesses two distinct areas of Flash, User MAT (768KByte) and User Boot MAT (8KByte). The User Boot MAT is a separate area of FLASH from User MAT, intended to hold user boot code.

A custom boot stub could be programmed into User Boot MAT which allows programming and erasing of the User MAT in User Mode, without erasing the contents of the User Boot MAT. Once User Boot Mode is entered, code contained in the User Boot MAT is executed. This differs to Boot mode, as Boot mode erases all User MAT and requires an auto-baud on a fixed SCI port to be performed. The existence of the User Boot Mat therefore allows an alternative communications port to be used for further code download to the User MAT. Programming of the User Boot Mat may only be performed in boot mode.

The user may place the H8SX/1582 device provided on a CPU board for the H8SX1582 board in user boot mode by fitting jumper J13. The Boot procedure must then be performed for entry into user boot mode. The Boot LED should light, suggesting a transition to user boot mode.

The user boot mode settings for this CPU board are shown in Table 7-3 below:

MD1	MD0	LSI State after Reset End	FDT Settings	
			A	B
0	1	User Boot Mode	1	1

Table 7-3: Mode pin settings

7.1.3.User Mode

For the device to enter User Mode, reset must be held active while the microcontroller mode pins are held in states specified for User Mode operation. 100K pull up and pull down resistors are used to set the pin states during reset.

The H8SX/1582 supports 4 user modes. The memory map in all of these modes is 16Mbyte in size. The default user mode for CPU board supporting H8SX1582 is 7.

MD1	MD0	LSI State after Reset End	FDT Settings	
			A	B
1	1	User Mode	0	1

Table 7-4: Mode pin settings

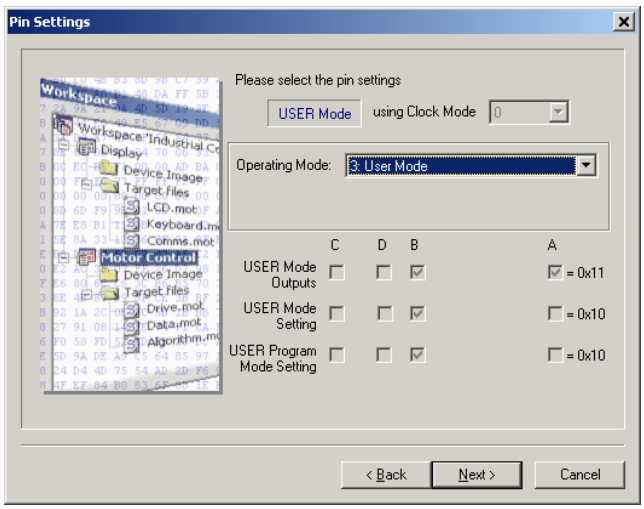


Figure 7-2: User mode FDT configuration

Chapter 8.Programming Methods

All of the Flash ROM on the device (i.e. both MATs) can be programmed when the device is in Boot mode. Once in boot mode, the boot-loader program pre-programmed into the microcontroller executes and attempts a connection with a host (for example a PC). On establishing a connection with the microcontroller, the host may then transmit program data to the microcontroller via the appropriate programming port.

Table 8-1 below shows the programming port for this Renesas Microcontroller and its associated pins

Programming Port Table – Programming port pins and their CPU board signal names			
SCI4	TXD4, PIN 5	RXD4, PIN 7	SCK4, PIN 8
CPU board Signal Name	PTTX	PTRX	PTCK

Table 8-1: Serial Port Boot Channel

8.1.Serial Port Programming

This sequence is not required when debugging using the E8 supplied with the kit.

The microcontroller must enter boot mode for programming, and the programming port must be connected to a host for program download. To execute the boot transition, and allow programs to download to the microcontroller, the user must perform the following procedure:

Connect a 1:1 serial cable between the host PC and the CPU board

Depress the BOOT switch and keep this held down

Depress the RESET switch once, and release

Release the BOOT switch

The Flash Development Toolkit (FDT) is supplied to allow programs to be loaded directly on to the board using this method.

8.2.E10A Header

This device supports an optional E10A debugging interface. The E10A provides additional debugging features including hardware breakpoints and hardware trace capability. (Check with the website at www.renesas.com or your distributor for a full feature list).

To utilise the E10A the user will need to fit a 14 way boxed header to J7. To enable the E10A functions the user should also fit a jumper link in position J6.

When J6 is fitted the microcontroller will not operate correctly unless operated via the E10A.

Chapter 9.Headers

9.1.Microcontroller Headers

Table 9-1 to Table 9-4 show the microcontroller pin headers and their corresponding microcontroller connections. The header pins connect directly to the microcontroller pin unless otherwise stated.

J1					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	SCIbRX	1	2	SCIbCK	2
3	PIN3	3	4	UC_VCC	4
5	PTTX	5	6	GROUND	6
7	PTRX	7	8	PTCK	8
9	TDO	9	10	PIN10	10
11	TRIGb	11	12	LED3	12
13	PIN13	13	14	MO_Up	14
15	MO_Vp	15	16	PIN16	16
17	MO_Wp	17	18	CTSRTS	18
19	PIN19	19	20	PIN20	20
21	PIN21	21	22	PIN22	22
23	TRISTn	23	24	GROUND	24
25	MO_Un	25	26	UC_VCC	26
27	MO_Vn	27	28	MO_UD	28
29	PIN29	29	30	MO_Wn	30

Table 9-1: J1

J2					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	PIN31	31	2	PIN32	32
3	PIN33	33	4	PIN34	34
5	PIN35	35	6	IO_0	36
7	PIN37	37	8	IO_1	38
9	IO_2	39	10	IO_3	40
11	IO_4	41	12	IO_5	42
13	PIN43	43	14	IO_6	44
15	IO_7	45	16	UC_VCC	46
17	IRQ0	47	18	GROUND	48
19	IRQ1	49	20	GROUND	50
21	DLCDRS	51	22	IRQ2	52
23	IRQ3	53	24	SCIaTX	54
25	SCIaRX	55	26	SCIaCK	56
27	ADTRG	57	28	SW1	58
29	SW2	59	30	SW3	60

Table 9-2: J2

J3					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	DLCD7	61	2	GROUND	62
3	PIN63	63	4	UC_VCC	64
5	DLCDE	65	6	DLCD6	66
7	DLCD5	67	8	DLCD4	68
9	TMR0	69	10	TMR1	70
11	PIN71	71	12	PIN72	72
13	PIN73	73	14	TRSTn	74
15	TMS	75	16	TDI	76
17	TCK	77	18	PIN78	78
19	RESn	79	20	NMI	80
21	TRIGa	81	22	UC_VCC	82
23	CON_XTAL	83	24	CON_EXTAL	84
25	GROUND	85	26	EMLE	86
27	SCIcTX	87	28	PIN88	88
29	SCIcRX	89	30	SCIcCK	90

Table 9-3: J3

J4					
Pin	Circuit Net Name	Device Pin	Pin	Circuit Net Name	Device Pin
1	E8_BUSY	91	2	MD1_E8B	92
3	AD4	93	4	AD5	94
5	AD6	95	6	AD7	96
7	AD0	97	8	AD1	98
9	AD2	99	10	AVcc	100
11	AD3	101	12	AVss	102
13	AD_POT	103	14	AVcc	104
15	PIN105	105	16	PIN106	106
17	PIN107	107	18	PIN108	108
19	PIN109	109	20	PIN110	110
21	PIN111	111	22	MD0_E8A	112
23	LED0	113	24	IIC_SDA	114
25	LED1	115	26	PIN116	116
27	IIC_SCL	117	28	LED2	118
29	IIC_EX	119	30	SCIbTX	120

Table 9-4: J4

9.2.Application Headers

Table 9-5 and Table 9-6 below show the standard application header connections.

JA1								
Pin	Generic Header Name		CPU board Signal Name	Device Pin	Pin	Header Name	CPU board Signal Name	Device Pin
1	Regulated Supply 1		5V		2	Regulated Supply 1	GROUND	
3	Regulated Supply 2		3V3		4	Regulated Supply 2	GROUND	
5	Analogue Supply		AVcc	100,104	6	Analogue Supply	AVss	102
7	Analogue Reference		AVref		8	ADTRG	ADTRG	57
9	ADC0	I0	AD0	97	10	ADC1 I1	AD1	98
11	ADC2	I2	AD2	99	12	ADC3 I3	AD3	101
13	DAC0		DAC0		14	DAC1	DAC1	
15	IOPort		IO_0	36	16	IOPort	IO_1	38
17	IOPort		IO_2	39	18	IOPort	IO_3	40
19	IOPort		IO_4	41	20	IOPort	IO_5	42
21	IOPort		IO_6	44	22	IOPort	IO_7	45
23	Open drain	IRQAEC	IRQ3	53	24	I²C Bus - (3rd pin)	IIC_EX	119
25	I²C Bus		IIC_SDA	114	26	I²C Bus	IIC_SCL	117

Table 9-5: JA1 Standard Generic Header

JA2								
Pin	Generic Header Name		CPU board Signal Name	Device Pin	Pin	Header Name	CPU board Signal Name	Device Pin
1	Open drain		RESn	79	2	External Clock Input	EXTAL	84*
3	Open drain		NMIn	80	4	Regulated Supply 1	Vss1	
5	Open drain output		WDT_OVF		6	Serial Port	SCIaTX	54
7	Open drain	WUP	IRQ0	47	8	Serial Port	SCIaRX	55
9	Open drain		IRQ1	49	10	Serial Port	SCIaCK	56
11	Up/down		MO_UD	28	12	Serial Port Handshake	CTS/RTS	18
13	Motor control		MO_Up	14	14	Motor control	MO_Un	25
15	Motor control		MO_Vp	15	16	Motor control	MO_Vn	27
17	Motor control		MO_Wp	17	18	Motor control	MO_Wn	30
19	Output		TMR0	69	20	Output	TMR1	70
21	Input		TRIGa	81	22	Input	TRIGb	11
23	Open drain		IRQ2	52	24	Tristate Control	TRSTn	74
25	SPARE		-		26	SPARE	-	

Table 9-6: JA2 Standard Generic Header

JA5									
Pin	Generic Header Name		CPU board Signal Name	Device Pin	Pin	Header Name		CPU board Signal Name	Device Pin
1	ADC4	I4	AD4	93	2	ADC5	I5	AD5	94
3	ADC6	I6	AD6	95	4	ADC7	I7	AD7	96
5	CAN		CAN1TX		6	CAN		CAN1RX	
7	CAN		CAN2TX		8	CAN		CAN2RX	
9	Reserved				10	Reserved			
11	Reserved				12	Reserved			
13	Reserved				14	Reserved			
15	Reserved				16	Reserved			
17	Reserved				18	Reserved			
19	Reserved				20	Reserved			
21	Reserved				22	Reserved			
23	Reserved				24	Reserved			

Table 9-7: JA5 Optional Generic Header

JA6									
Pin	Generic Header Name		CPU board Signal Name	Device Pin	Pin	Header Name		CPU board Signal Name	Device Pin
1	DMA		DREQ		2	DMA		DACK	
3	DMA		TEND		4	Standby (Open drain)		STBYn	
5	Host Serial	SCIdTX	RS232TX	5*	6	Host Serial	SCIdRX	RS232RX	7*
7	Serial Port		SCIbRX	1	8	Serial Port		SCIbTX	120
9	Serial Port	Synchronous	SCIcTX	87	10	Serial Port		SCIbCK	2
11	Serial Port	Synchronous	SCIcCK	90	12	Serial Port	Synchronous	SCIcRX	89
13	Reserved				14	Reserved			
15	Reserved				16	Reserved			
17	Reserved				18	Reserved			
19	Reserved				20	Reserved			
21	Reserved				22	Reserved			
23	Reserved				24	Reserved			
25	Reserved				26	Reserved			

Table 9-8: JA6 Optional Generic Header

* Marked pins are affected by option links.

Chapter 10.Code Development

10.1.Overview

Note: For all code debugging using Renesas software tools, the CPU board must either be connected to a PC serial port via a serial cable or a PC USB port via an E8. An E8 is supplied with the RSK product.

The HMON embedded monitor code is modified for each specific Renesas microcontroller. HMON enables the High-performance Embedded Workshop (HEW) development environment to establish a connection to the microcontroller and control code execution. Breakpoints may be set in memory to halt code execution at a specific point.

Unlike other embedded monitors, HMon is designed to be integrated with the user code. HMon is supplied as a library file and several configuration files. When debugging is no longer required, removing the monitor files and library from the code will leave the user's code operational.

The HMON embedded monitor code must be compiled with user software and downloaded to the CPU board, allowing the users' code to be debugged within HEW.

Due to the continuous process of improvements undertaken by Renesas the user is recommended to review the information provided on the Renesas website at www.renesas.com to check for the latest updates to the Compiler and Debugger manuals.

10.2.Compiler Restrictions

The compiler supplied with this RSK is fully functional for a period of 60 days from first use. After the first 60 days of use have expired, the compiler will default to a maximum of 64k code and data. To use the compiler with programs greater than this size you will need to purchase the full tools from your distributor.

Warning: The protection software for the compiler will detect changes to the system clock. Changes to the system clock back in time may cause the trial period to expire prematurely.

10.3.Mode Support

The HMON library is built to support 16Mbyte Advanced Mode only for the H8SX family.

10.4.Breakpoint Support

The device does not include a user break controller. No breakpoints can be located in ROM code. However, code located in RAM may have multiple breakpoints limited only by the size of the On-Chip RAM. To debug with breakpoints in ROM you need to purchase the E10A-USB on-chip debugger at additional cost.

10.5.Code located in RAM

Double clicking in the breakpoint column in the HEW code window sets the breakpoint. Breakpoints will remain unless they are double clicked to remove them. (See the Tutorial Manual for more information on debugging with the HEW environment.)

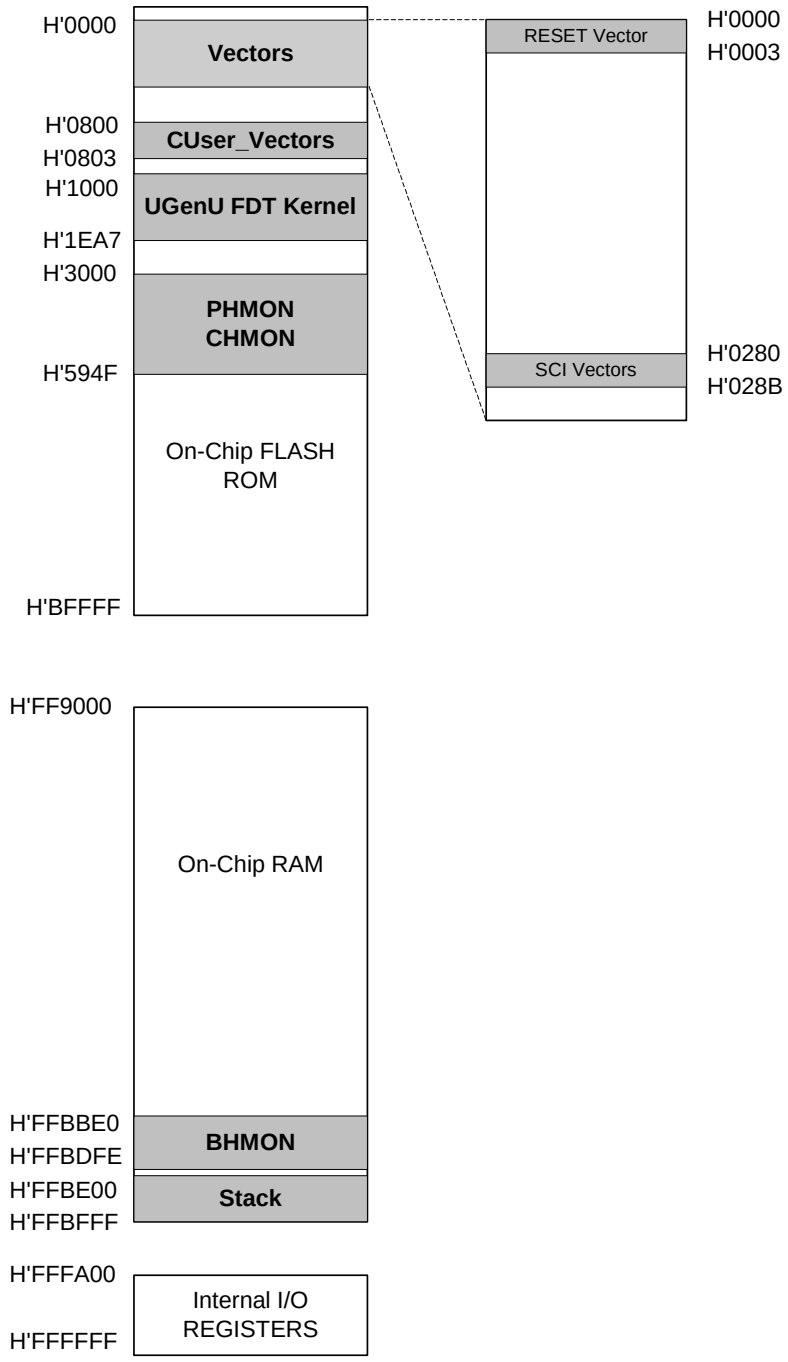
10.6.HMon Code Size

HMON is built along with the user's code. Certain elements of the HMON code must remain at a fixed location in memory. The following table details the HMON components and their size and location in memory. For more information, refer to the map file when building code.

Section	Description	Start Location	Size (H'bytes)
RESET_VECTOR	HMON Reset Vector (Vector 0) Required for Start-up of HMON	H' 0000 0000	0x0004
SCI_VECTORS	HMON Serial Port Vectors (Vector 160, 161, 162, 163)	H'0000 0280	0x000C
PHMON	HMON Code	H'0000 3000	0x278C
CHMON	HMON Constant Data	H'0000 5730	0x0136
BHMON	HMON Un-initialised data	Variable	0x021F
UGenU	FDT Kernel. This is at a fixed location and must not be moved. Should the kernel need to be moved it must be re-compiled.	H'0000 1000	0xEA8
CUser_Vectors	Pointer used by HMON to point to the start of user code.	H'0000 0800	0x0004

10.7.Memory Map

The memory map shown in this section visually describes the locations of program code sections related to HMON, the FDT kernels and the supporting code within the ROM/RAM memory areas of the microcontroller.



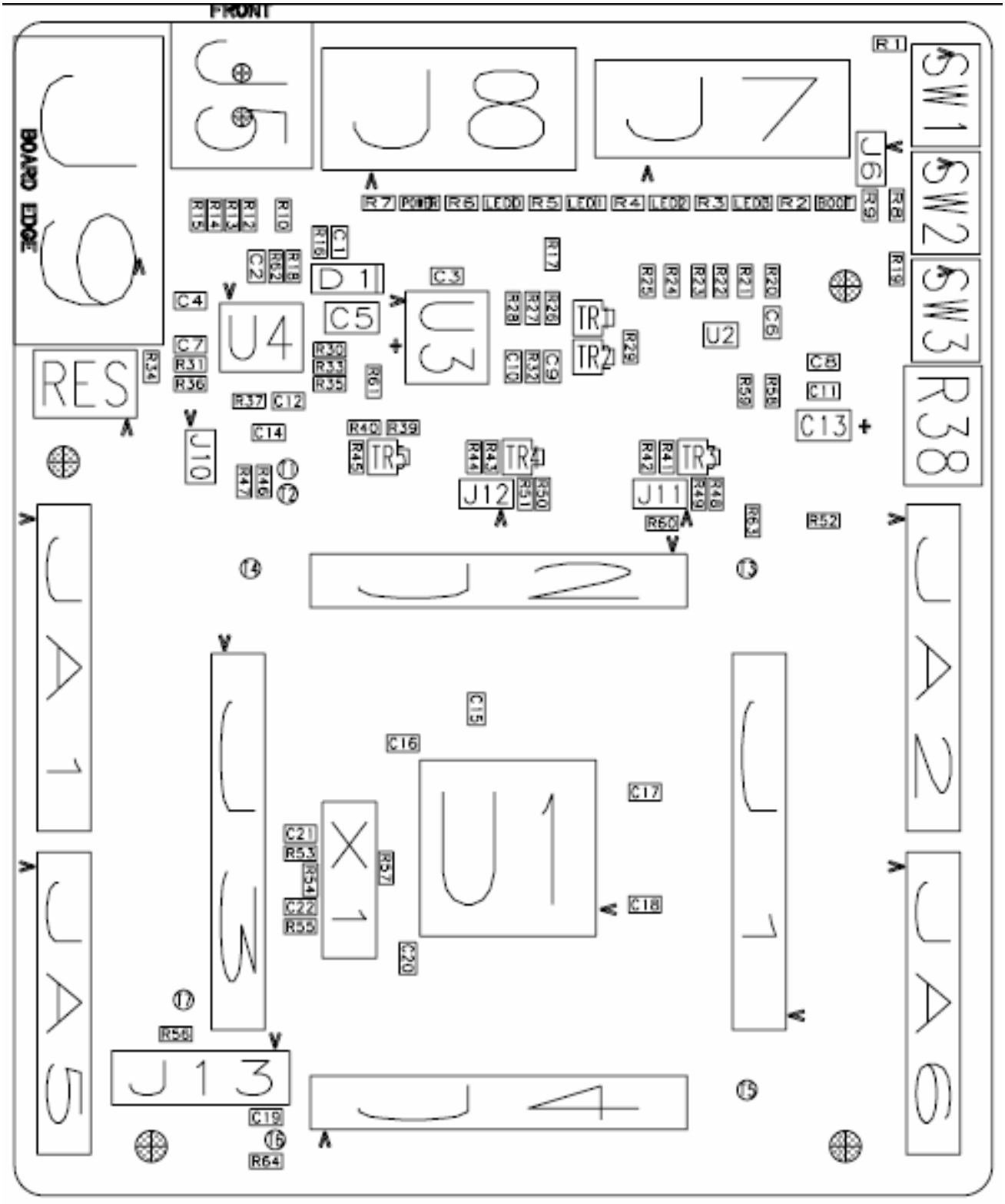
10.8.Baud Rate Setting

HMON is initially set to connect at 250000Baud. The value set in the baud rate register for the microcontroller must be altered if the user wishes to change either the serial communication baud rate of the serial port or the operating frequency of the microcontroller. This value is defined in the hmonserialconfiguser.h file, as SCI_CFG_BRR (see the Serial Port section for baud rate register setting values). The project must be re-built and the resulting code downloaded to the microcontroller once the BRR value is changed. Please refer to the HMON User Manual for further information.

10.9.Interrupt mask sections

HMON has an interrupt priority of 6. The serial port has an interrupt priority of 7. Modules using interrupts should be set to lower than this value (6 or below), so that serial communications and debugging capability is maintained.

Chapter 11. Component Placement



Chapter 12. Additional Information

For details on how to use High-performance Embedded Workshop (HEW), refer to the HEW manual available on the CD or installed in the Manual Navigator.

For information about the H8SX/1582 series microcontrollers refer to the H8SX/1582 *Series Hardware Manual*

For information about the H8SX/1582 assembly language, refer to the H8 *Series Programming Manual*

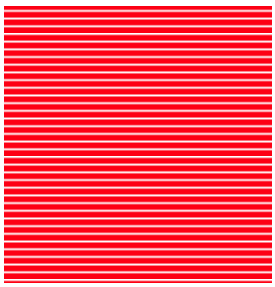
Further information available for this product can be found on the Renesas website at:

http://www.renesas.com/rsk

General information on Renesas Microcontrollers can be found on the following website.

Global: http://www.renesas.com/

Renesas Starter Kit for H8SX1582
User's Manual



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Renesas Starter Kit

RSK H8SX1582 Tutorial Manual

RENESAS SINGLE-CHIP MICROCOMPUTER

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www.renesas.com

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Chapter 1. Preface

Cautions

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Glossary

BRR	Baud Rate Register	ISR	Interrupt Service Routine
ERR	Error Rate	PWM	Pulse Width Modulation
HMON	Embedded Monitor	CPU	Central Processing Unit
RSK	Renesas Starter Kit	PC	Program Counter
RSO	Renesas Solutions Organisation.	IRQ	Interrupt ReQuest
HEW	High performance Embedded Workshop	NMI	Non-Maskable Interrupt
CCR	Condition Code Register	RTE	ReTurn from Exception
EXR	EXtended control Register	LED	Light Emitting Diode
SR	Status Register	RTC	Real Time Clock

Chapter 2.Introduction

This manual is designed to answer, in tutorial form, the most common questions asked about using a Renesas Starter Kit (RSK): The tutorials help explain the following:

- How do I compile, link, download, and run a simple program on the RSK?
- How do I build an embedded application?
- How do I use Renesas' tools?

The project generator will create a tutorial project with two selectable build configurations

- 'Debug' is a project built with the debugger support included.
- 'Release' build demonstrating code suitable for release in a product.

Files referred to in this manual are installed using the project generator as you work through the tutorials. The tutorial examples in this manual assume that installation procedures described in the RSK Quick Start Guide have been completed. Please refer to the Quick Start Guide for details of preparing the configuration.

NOTE: These tutorials are designed to show you how to use the RSK and are not intended as a comprehensive introduction to the High performance Embedded Workshop (HEW) debugger or the compiler tool-chains – please consult the relevant user manuals for more in-depth information.

Chapter 3.Tutorial Project Workspace

The workspace includes all of the files for two build configurations. The tutorial code is common to both the Debug and the Release build configurations. The tutorial is designed to show how code can be written, debugged then downloaded without the debug monitor in a ‘Release’ situation.

The build configuration menu in High-performance Embedded Workshop (HEW) allows the project to be configured such that certain files may be excluded from each of the build configurations. This allows the inclusion of the debug monitor within the Debug build, and its exclusion in the Release build. Contents of common C files are controlled with defines set up in the build configuration optionss and #ifdef statements within the source files.

Maintaining only one set of project files means that projects are more controllable.

The HMON monitor code is provided in a pre-compiled library for inclusion in the user code. This library must be included in the tool chain linker settings. There are some configuration options provided to the user. These are provided in the hmonserialconfiguser.c and hmonconfiguser.c files and the header files; hmonserialconfiguser.h, hmonserialstruct.h, and hmonconfiguser.c. More information on this is provided in the HMon User Manual.

Chapter 4. Project Workspace

4.1.Introduction

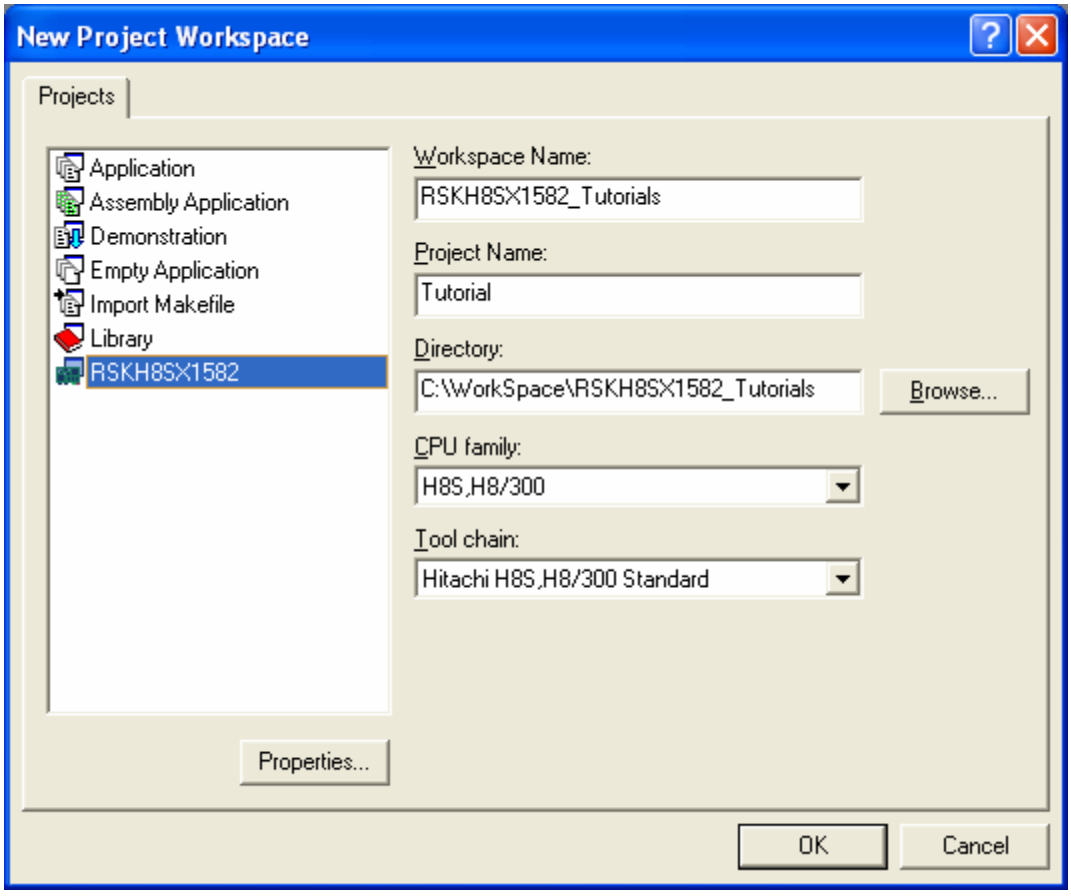
HEW is an integrated development tool that allows the user to write, compile, program and debug a software project on any of the Renesas Microcontrollers. HEW will have been installed during the software installation for the RSK product.

To begin using the RSK, this manual will describe the stages required to create and debug the supplied tutorial code.

4.2.Creating a new Project Workspace

To look at the program, start High-performance Embedded Workshop from the Windows Start Menu or from its icon:

Open a new tutorial workspace from the [File -> New Workspace…] menu or select 'Create a new project workspace' when presented with the 'Welcome!' dialog.



The example above shows the New Project Workspace dialog with the RSKH8SX1582 selected.

- Select the 'H8S, H8/300' CPU family and 'Hitachi H8S,H8/300 Standard' Tool-chain for the RSK
- Select the 'RSKH8SX1582' Project type for the RSK from the project list.
- Enter a name for the workspace, all your files will be stored under a directory with this name.

- The project name field will be pre-filled to match the workspace name above; this name may be changed.
  Note: HEW allows you to add multiple projects to a workspace. You may add the sample code projects later so you may wish to choose a suitable name for the Tutorial project now.
- Click OK to start the RSK Project Generator wizard.

The next dialog presents the example projects available. Choose the Tutorial code which will be explained later in this manual. There is also an option for Sample code which provides examples for using various peripherals. This will open a new dialog allowing the selection of many code examples for the peripheral modules of the device. The final option is for an application build where the debugger is configured but there is no program code. This project is suitable for the user to add code without having to configure the debugger.

- Select 'Tutorial' as the type of project to generate and then click <Next>.
- Click <Finish> to create the project

The project generator wizard will display a confirmation dialog. Press <OK> to create the project and insert the necessary files.

A tree showing all the files in this project will appear in the HEW Workspace window.

- To view the file main.c double click on the file in the Workspace window. A new window will open showing the code.

4.3.Build Configurations and Debug Sessions

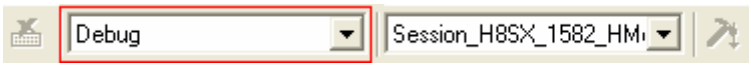
The workspace that has been created contains two Build Configurations and two Debug Sessions. The Build Configuration allows the same project to be built but with different compiler options. The options available to the user are described fully in the HEW Users Manual.

4.3.1.Build Configuration

The build configurations are selected from the left hand drop down list on the tool bar. The options available are Debug and Release. The debug build is configured for use with the debugger. The Release build is configured for final ROM-able code.

A common difference between the two builds may be the optimisation settings. With Optimisation turned on the Debugger may seem to execute code in an unexpected order. To assist in debugging it is often helpful to turn off optimisation on the code being debugged.

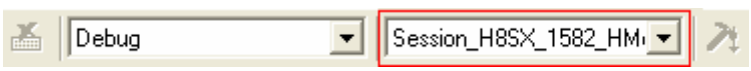
- Select the Debug Build Configuration.



4.3.2.Debug Session

The debug sessions are selected from the right hand drop down list on the tool bar. The options vary between RSK however one will always start Debug and include the type of debug interface. The alternate selection will be 'DefaultSession'. This purpose of the debug session is to allow the use of different debugger targets or different debugger settings on the same project.

- Select the 'Session_H8SX_1582_HMon' debug session.



Chapter 5. Building the Tutorial Project

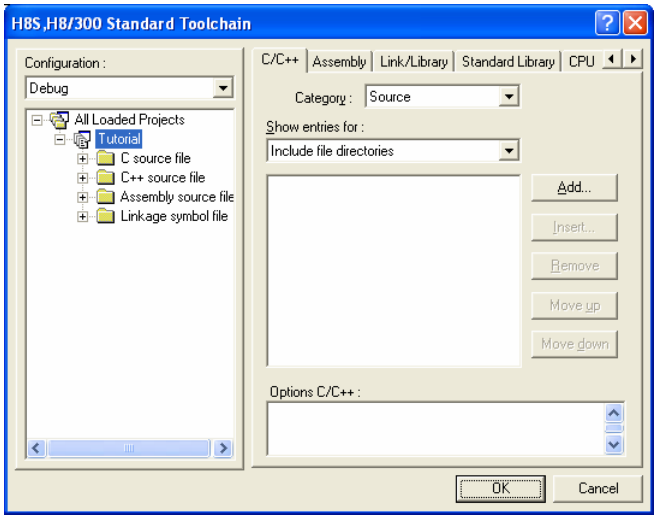
The tutorial project build settings have been pre-configured in the tool-chain options. To view the tool chain options select the 'Build' Menu item and the relevant tool-chain. This should be the first option(s) on the drop down menu.

The dialog that is displayed will be specific to the selected tool-chain.

The configuration pane on the left hand side will exist on all the tool-chain options. It is important when changing any setting to be aware of the current configuration that is being modified. If you wish to modify multiple or all build configurations this is possible by selecting 'All' or 'Multiple' from the 'Configuration' drop down list.

- Review the options on each of the tabs and 'Category' drop down lists to be aware of the options available.

When complete close the dialog box by clicking <OK>.



5.1.Building Code

There are three short cuts available for building the project.

- Select the 'Build All' tool bar button.

  This will build everything in the project that has not been excluded from the build. This includes the standard library.

- Select the 'Build' tool bar button.

  This will build all files that have changed since the last build. The standard library will not be built unless an option has been changed.

- Press 'F7'

  This is equivalent to pressing the 'Build' button described above.

- Build the project now by pressing 'F7' or pressing one of the build icons as shown above.

During the build each stage will be reported in the Output Window.

The build will complete with an indication of errors and warnings encountered during the build.

5.2.Connecting the debugger

For this tutorial it is not necessary to provide an external power supply to the board, the power will be provided by the E8 from the USB port. Please be aware that if you have too many devices connected to your USB port it may be shut down by Windows. If this happens remove some devices and try again. Alternatively you can provide an external power source, taking care to ensure the correct polarity and voltage.

The Quick Start Guide provided with the RSK board gives detailed instructions on how to connect the E8 to the host computer. The following assumes that the steps in the Quick Start Guide have been followed and the E8 drivers have been installed.

- Connect the E8 debugger to the USB port on your computer.
- Connect the E8 Debugger to the target hardware ensuring that it is plugged into the connector marked E8 which is nearest the power connector.
- If supplying external power to the board this can be turned on now.

5.3.Connecting to the target with E8Direct & HMon

This section will take you through the process of connecting to the device, programming the Flash and executing the code.

The E8 provides a interface called E8DIRECT to allow HMon embedded debugger to connect to the target device.

To provide flash programming capabilities the FDT Flash configuration wizard must be configured. This process is only required once in a project. The settings provide information to HMon to allow the re-programming of the device.

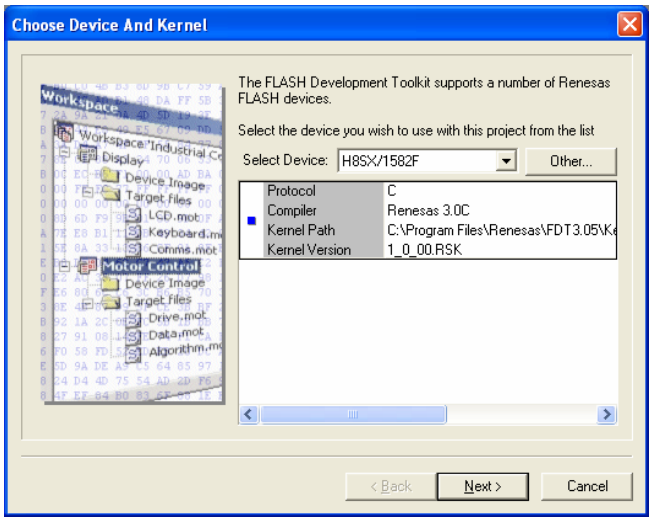
- Select the FDT Wizard from the FDT Tool Bar

If the flash kernel is already configured then a confirmation window will open with the kernel settings. To modify any of the settings just double click on the item. If FDT is already configured then please proceed to section 5.3.1 Connecting to HMon.

The first stage is to select the specific device from the installed kernels. The installer will have added the kernel to the FDT registry so it will appear under the device list drop down menu. If for any reason the kernel has to be re-build such as the crystal frequency on the board has changed, then the installation path is:

<FDT Installation>\Kernels\ProtC\1582\Renesas\1_0_00.RSK

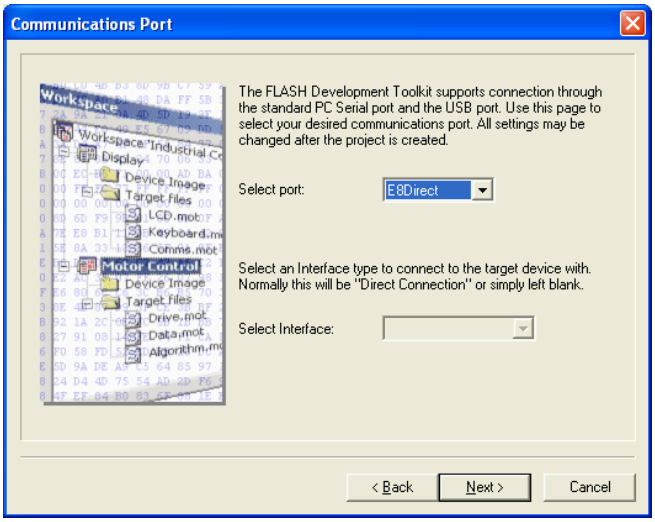
- Select the Device on the RSK from the drop down list.
- In the sub pane, select the kernel version that ends in '.RSK'.
- Press <Next>.



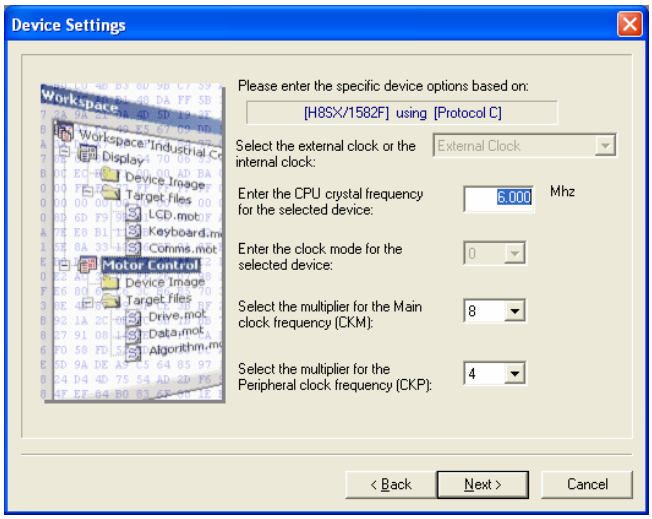
If you have copied the kernel to another location to modify for a different crystal frequency, the device will not be listed in the sub pane. In this case:

- Press <Other…> and navigate to your modified kernel.

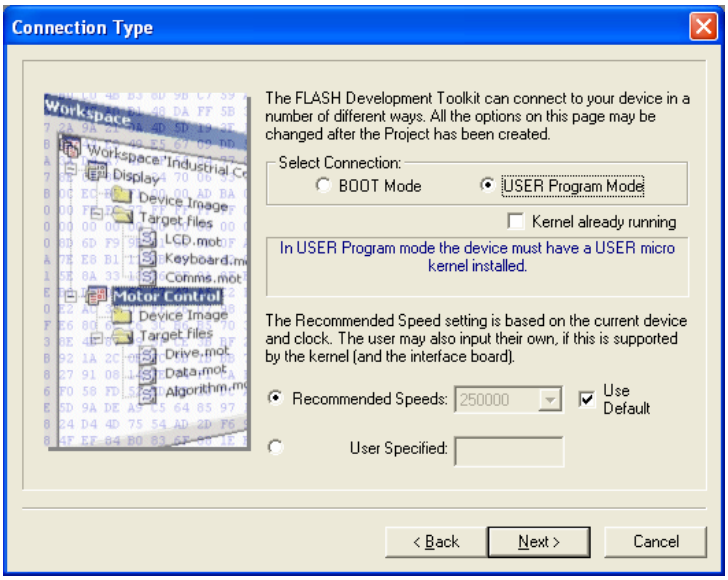
- Select E8DIRECT as the communication Port
- Press <Next>.


Communications Port
The FLASH Development Toolkit supports connection through the standard PC Serial port and the USB port. Use this page to select your desired communications port. All settings may be changed after the project is created.
Select port:
E8Direct
Select an Interface type to connect to the target device with. Normally this will be "Direct Connection" or simply left blank.
Select Interface:
< Back
Next >
Cancel

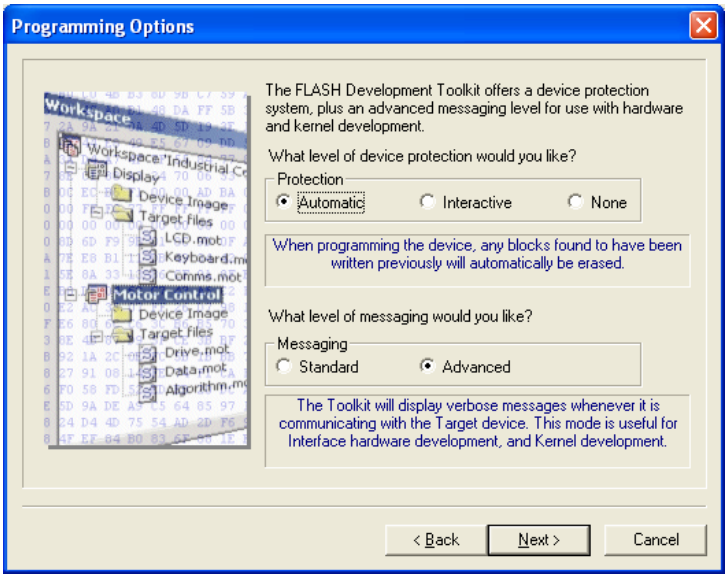
- The default settings are suitable for an un-modified RSK board.
- Confirm the Crystal Frequency matches the board.
- Confirm the main clock frequency multiplier.
- Confirm the peripheral clock multiplier.
- Press <Next>.


Device Settings
Please enter the specific device options based on:
[H8SX/1582F] using [Protocol C]
Select the external clock or the internal clock:
External Clock
Enter the CPU crystal frequency for the selected device:
6.000
Mhz
Enter the clock mode for the selected device:
0
Select the multiplier for the Main clock frequency (CKM):
8
Select the multiplier for the Peripheral clock frequency (CKP):
4
< Back
Next >
Cancel

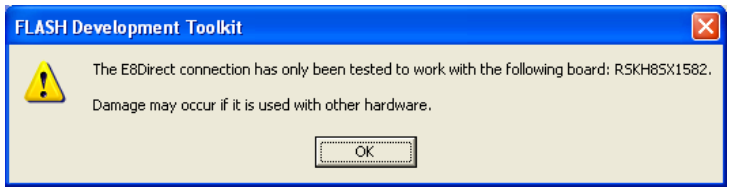
- Ensure that 'USER Program Mode' is selected.
- Confirm that 'Use Default' is selected.
- Press <Next>.


Connection Type
The FLASH Development Toolkit can connect to your device in a number of different ways. All the options on this page may be changed after the Project has been created.
Select Connection:
BOOT Mode
USER Program Mode
Kernel already running
In USER Program mode the device must have a USER micro kernel installed.
The Recommended Speed setting is based on the current device and clock. The user may also input their own, if this is supported by the kernel (and the interface board).
Recommended Speeds:
250000
Use Default
User Specified:
< Back
Next >
Cancel

- Confirm the default selections of ‘Automatic’ and ‘Advanced’.
- Press <Next>.



- The following warning dialog will be displayed.
- Press <OK>.

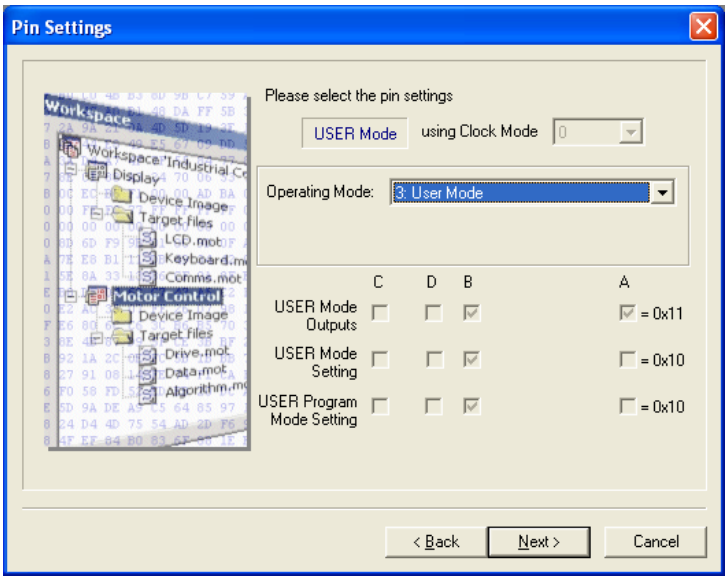

FLASH Development Toolkit
The E8Direct connection has only been tested to work with the following board: RSKH8SX1582.
Damage may occur if it is used with other hardware.
OK

To communicate with the RSK FDT and HMon need to be able to change the operating mode of the microcontroller. To do this there are settings to control the state of the Mode pins via the E8Direct interface. These settings are confirmed in the following screens.

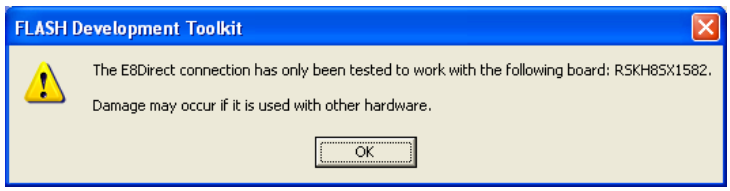
Unless you are very sure that the mode pin settings need to change. Do not modify the default settings.

Damage to the microcontroller can be sustained with incorrect settings.

- Confirm the mode pin settings.
- Press <Next>.

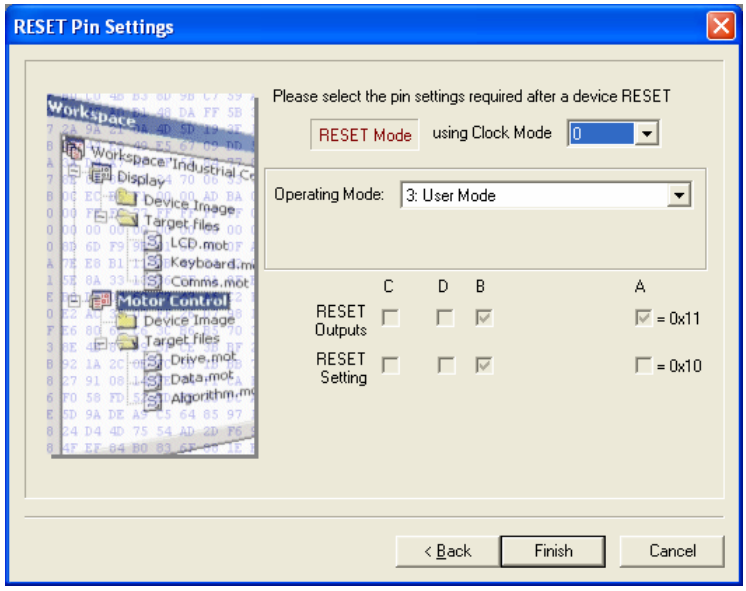


- The following warning dialog will be displayed.
- Press <OK>.


FLASH Development Toolkit
The E8Direct connection has only been tested to work with the following board: RSKH8SX1582.
Damage may occur if it is used with other hardware.
OK

Damage to the microcontroller can be sustained with incorrect settings.

- Confirm the mode pin settings.
- Press <Finish>.



The Flash configuration has now been completed.

If you have changed any workspace settings now is a good time to save the workspace.

- Select [File' -> 'Save Workspace'].

5.3.1.Connecting To HMon

We can now attempt to connect to the target device.

- Press the Green 'Connect' Icon.

HMon is able to discover the internal flash configuration of the device from the FDT kernel we configured earlier. HMon also needs information on the location of the IO registers and internal / external RAM. This information is stored in a '.TCF' file. The TCF file is supplied and registered with HEW. As it is possible to have TCF files with slightly different configurations the following dialog is displayed to allow selection.

- Select the TCF file that applies to your RSK.
- Press <OK>.

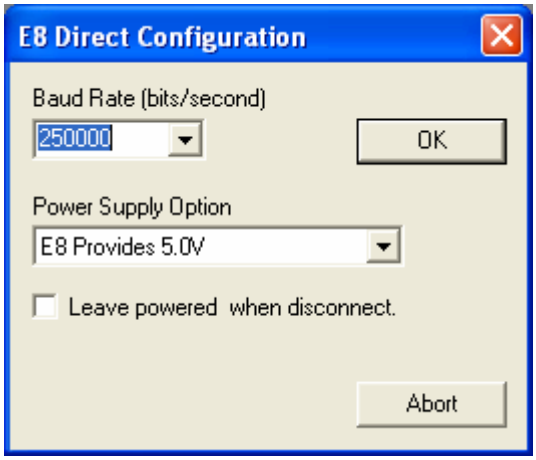
A further dialog will be displayed to confirm if it acceptable to assume only one E8 device will be connected to the host computer while using this project. This is the preferred operating mode. While it is possible to use more than one E8 device this is not recommended.

• Press 'Yes' to assume only one E8 device is connected while in this project.	

Note: If you have not followed the Quick Start Guide, additional driver messages may be displayed here. Please refer to the Quick Start Guide for driver installation.

The following dialog allows the selection of the baud rate and power options for connection to the target board and monitor code. The default settings are shown below. If the target board is modified with a different crystal frequency then this setting will need to be changed. (Note in this case the kernel will also need to be re-compiled).

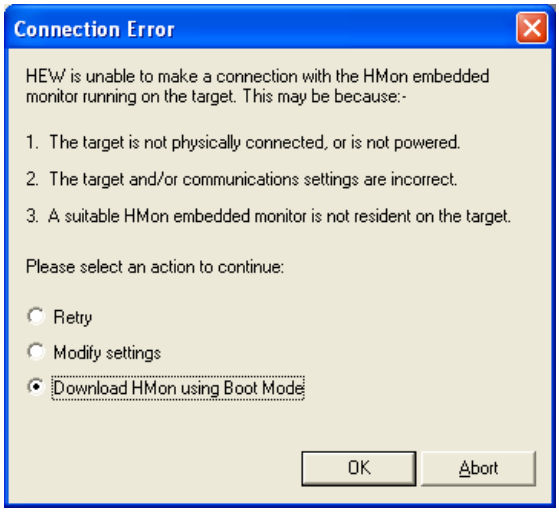
- Confirm the settings shown and press <OK>.



HMon will attempt to connect to the RSK. If it succeeds then the Output window in HEW will show the 'Connected' message. In this case please proceed to Chapter 6.

If the connection fails you will be returned to the previous dialog. This is likely to be caused by a connection error with the RSK and the E8. It can also be caused if the RSK has not got a working copy of the HMon target code programmed. Check the settings and if all settings are OK but the connection still fails then a Boot Mode download will be required. Press <Abort>.

- Select 'Download HMon using Boot Mode'.
- Press <OK>.



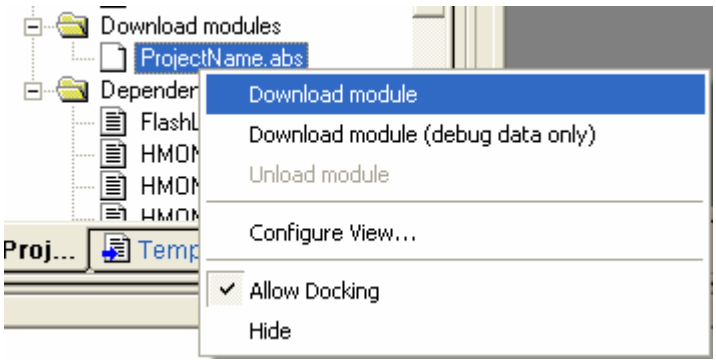
On completion of the download HMon will automatically re-connect to the monitor and revert back to User programming mode.

Chapter 6.Downloading and Running the Tutorial

Once the code has been built in HEW it needs to be downloaded to the RSK.

Now that you are connected to the target you should see an additional category in the workspace view called ‘Download Modules’

- Right click on the download module listed and select ‘Download module’

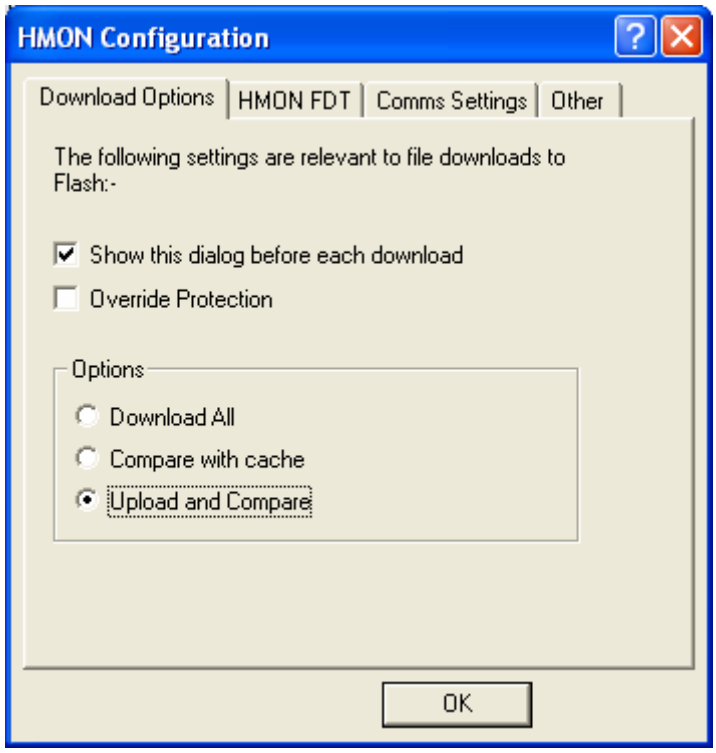


The download options dialog will be displayed.

This dialog provides various options for HMon operation and downloading. This dialog allows the re-configuration of any HMon communication settings. Please review the settings in each tab.

HMon includes a cache of the current device program. This allows the number of reprogramming cycles to be reduced by not programming areas of the device that have not changed between compilations. On first connection the cache is empty. Selecting ‘Upload and Compare’ will read the program back from the device before comparing it to the cache.

- Select any of the download options shown.
- Press ‘OK’.



On completion the debugger and code are ready to be executed.

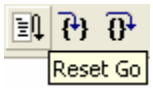
To start debugging we need to reset the debugger and target.

- Press ‘Reset CPU’ on the Debug Tool Bar.

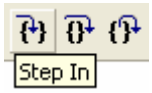
The File window will open the Tutorial code at the entry point. An arrow marks the current position of the program counter.

```
void Initialise(void)
{
    /* Interrupts MUST be enabled for HMon */
    set_imask_ccr(0);
    set_imask_exr(0);

    /* Renesas H8/SH Compiler Intrinsic function to copy initialised data to RAM */
    /* This function references the structure in the 'dbsct.c' source file */
    _INITSCT();

    /* Initialise all the required peripheral modules */
    HardwareSetup();

    /* main function including users code */
    Main();
```

We will now skip over the initialisation code and proceed to the main tutorial.

- Open the file called ‘resetprg.c’ by double clicking it in the project navigator.
- Place a breakpoint at the call to main(); by double clicking in the column containing the PC arrow, next to the line to break at; or selecting the line and pressing F9; or right click on the line and select ‘Toggle breakpoint’
- Press ‘Reset Go’ on the Debug Tool Bar. 

The code will execute to the breakpoint. At this point all the device initialisation will have been completed.

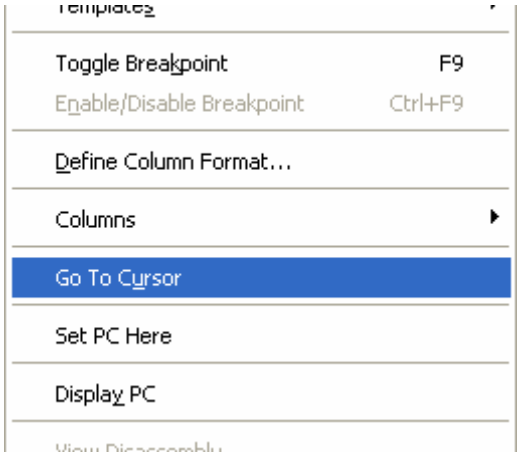
- Press ‘Step In’ on the Debug Tool Bar. 

The code window will open 'main.c' and show the new position of the program counter.

```
/***********************************************************************************
Function Name:  Main
Description:    Main function
Parameters:     none
Return value:   none
***********************************************************************************/
void main(void)
{
/* Reset the LCD module */
    InitialiseDisplay();

/* Display Renesas Splash Screen */
    DisplayString(LCD_LINE1,"Renesas");
    DisplayString(LCD_LINE2,NICKNAME);

/* Flash the user LEDs for some time or until a key is pressed. */
    FlashLEDs();

/* Flash the user LEDs at a rate set by the user potentiomenter (ADC) using
   interrupts. */
    TimerADC();

/* Demonstration of initialised variables. Use this funtion with the debugger. */
    Statics_Test();

/* End of the user program. This function must not exit. */
    for(;;);
}
/***********************************************************************************
End of function main
***********************************************************************************/
```

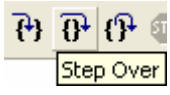
Support for the LCD display is included in the tutorial code. We do not need to be concerned about the details of the LCD interface – except that the interface is write-only and so is not affected if the LCD display is attached or not.

- Insert a breakpoint on the 'TimerADC();' function call.
- Right click on the 'FlashLEDs();' function and select 'Go to cursor'.



The code will run to the selected line and stop. A temporary breakpoint was automatically inserted in the code and then removed when the program stopped at the breakpoint.

- Press 'Step Over' on the Debug Tool Bar.



The code will run and flash the LEDs 200 times. The debugger will not stop running until all 200 flashes have completed or a button is pressed on the RSK.

- If the LEDs are still flashing press the SW1 button on the RSK to exit the FlashLEDs() function.

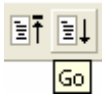
The code will run to the breakpoint we previously set on the Timer function.

There are several versions of the timer function depending upon the peripherals available in the device. The default function is TimerADC which we shall demonstrate here.

The timer function initialises an interrupt on an available internal timer. On a compare match in the timer module an interrupt is generated. In the TimerADC code version the interrupt reads the last ADC conversion for the external potentiometer and uses the result to set the next compare match value. The ADC conversion is then re-started.

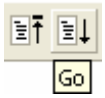
The interrupt initialisation is performed as part of the hardware setup. This is located in the file 'interrupts.c'.

- Open the file 'interrupts.c' by double clicking on the file in the workspace view.
- Review this file and find the interrupt function that changes the LED pins, INT_TGI1B_TPU1(void)
- Set a breakpoint on the line where the LED pins are modified.
- Press 'Go' or 'F5' to run the code from the current PC position.



The code will stop in the interrupt routine. It is now possible to step through the interrupt function.

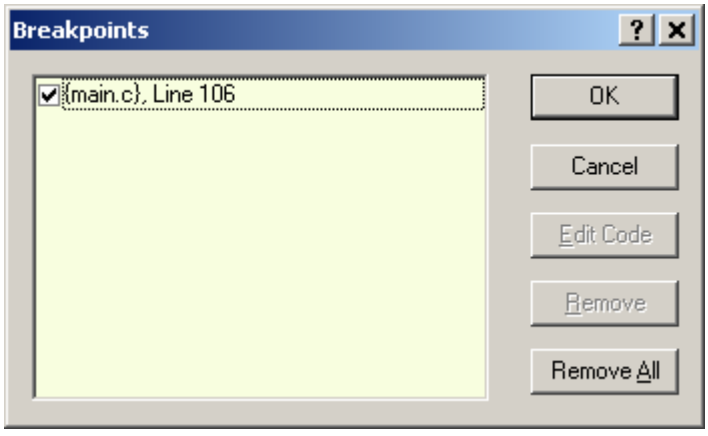
- Remove the breakpoint in the interrupt by double clicking again before exiting the function.
- Press 'Step Over' to step over the instruction and observe the LEDs turn off.
- Press 'Go' to run the code from the current PC position.



The code will now run to the infinite loop at the end of Main(). The user LEDs should now be flashing. If the RSK supports an ADC you can modify the flashing rate by adjusting the potentiometer on the board.

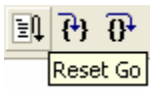
• Press 'Stop' on the debug tool bar.	

- Press 'CTRL-B' to open the breakpoint window.
- Select 'Remove All'
- Press <OK>.

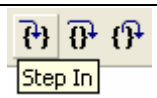


- Open the file ‘main.c’
- Insert a breakpoint on ‘StaticsTest();’.

The statics test is used to demonstrate that the initialisation has successfully copied all initialised variables from storage in flash to RAM.

• Press ‘Reset Go’ on the Debug Tool Bar.	

The code will stop at the breakpoint. (Press a button to bypass the flashing LED test.)

• Press ‘Step In’ on the Debug Tool Bar.	

It is possible to monitor variables during debugging of the code. To set up a ‘watch’ on a variable place the mouse over the variable. If the variable is available in the current context a tool-tip will be displayed with the current value of the variable.

- Hover the mouse over the ‘ucStr’ variable to see the tooltip value. Then Right click on the variable name and select ‘Instant Watch’.

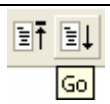
A dialog will open showing the variable and allowing further details to be explored.

- Press ‘Add’

The dialog will close and a new pane will open in the workspace containing the variable.

It is possible to see that the string has been successfully initialised to ‘ STATIC ‘.

- Set a breakpoint on the ‘DisplayString();’ function call inside the loop.

• Press ‘Go’ to run the code from the current PC position.	

When the program stops you can see the modified string displayed on the second line of the LCD.

Inspection of the watch pane will show that the first character of the variable string has been replaced with the first character of the constant replacement string.

- Remove the breakpoint
- Right click on the ‘DisplayString();’ function call after the loop and select ‘Go to cursor’.

This shows that the variable was initialised at program start up and can be overwritten with ‘TESTTEST’.

The modified string is also displayed on the LCD

You have now run the tutorial code and used many of the common features of the debugger. We suggest that you review the rest of the tutorial code as many functions have important information on the operation of the code, the compiler directives and comments on when they should or must be used. Please refer to Chapter 7 for more information on the project files.

Chapter 7.Project Files

7.1.Standard Project Files

The RSK tutorials are configured so that it is possible to provide the same tutorial code on multiple RSK products. This allows the evaluation of the different processor cores using equivalent code. To achieve this the following files are common between all device cores / Tool-chains.

Each of the tutorial files has expanded comment text describing the function of each code entry. Please refer to the source code for greater detail on the purpose and operation of the compiler specific details.

7.1.1.Initialisation code (Resetprg.c / resetprg.h)

This is the entry point of the main tutorial code. Depending upon the compiler used this file may be the actual entry point of the software or may be called during the initial setup of the environment.

```
void Initialise(void)
{
    /* Interrupts MUST be enabled for HMon */
    set_imask_ccr(0);
    set_imask_exr(0);

    /* Renesas H8/SH Compiler Intrinsic function to copy initialised data to RAM */
    /* This function references the structure in the 'dbsct.c' source file */
    _INITSCT();

    /* Initialise all the required peripheral modules */
    HardwareSetup();

    /* main function including users code */
    Main();
```

Initialisation of the variables used in the C compilers and initialisation of stack pointers are completed in the _INITSCT function for the H8 and SH compilers.

The call to ‘hardwaresetup()’ will initialise the device hardware and peripherals ready for the tutorial software.

The call to ‘main()’ will start the main demonstration code.

7.1.2.Board initialisation code (Hwsetup.c / hwsetup.h)

There are four common stages to the configuration of the microcontroller device. The code to demonstrate this is therefore split into four functions. Each function is written specifically for the device supported. The function calls are shown below.

```
/***********************************************************************************
Function Name:  HardwareSetup
Description:    Sets up hardware
Parameters: none
Return value: none
***********************************************************************************/

void HardwareSetup(void)
{
    ConfigureOperatingFrequency();

    ConfigurePortPins();

    EnablePeripheralModules();

    ConfigureInterrupts();
}

/***********************************************************************************
End of function HardwareSetup
***********************************************************************************/
```

7.1.3.Main tutorial code (Main.c / main.h)

The main tutorial code is common to all tutorial projects. The display initialisation and string display functions operate on the LCD display module. Check compatibility with a ks0066u controller and pin connection on the schematic before connecting an LCD module not supplied by Renesas.

```
/***********************************************************************************
Function Name:  Main
Description:    Main function
Parameters:     none
Return value:   none
***********************************************************************************/
void main(void)
{
/* Reset the LCD module */
    InitialiseDisplay();

/* Display Renesas Splash Screen */
    DisplayString(LCD_LINE1,"Renesas");
    DisplayString(LCD_LINE2,NICKNAME);

/* Flash the user LEDs for some time or until a key is pressed. */
    FlashLEDs();

/* Flash the user LEDs at a rate set by the user potentiomenter (ADC) using
   interrupts. */
    TimerADC();

/* Demonstration of initialised variables. Use this function with the debugger. */
    Statics_Test();

/* End of the user program. This function must not exit. */
    for(;;);
}
/***********************************************************************************
End of function main
***********************************************************************************/
```

Chapter 8.Additional Information

For details on how to use High-performance Embedded Workshop (HEW), refer to the HEW User manual available on the CD or from the Manual Navigator installed with this product.

For more information on the configuration and use of HMon please refer to the HMon User Manual installed from the CD.

Further information available for this product can be found on the Renesas web site at:

http://www.renesas.com/rsk

General information on Renesas Microcontrollers can be found at the following URL.

Global: http://www.renesas.com/

REVISION HISTORY

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		Page	Summary
1.00	25.11.2005	-	First issue

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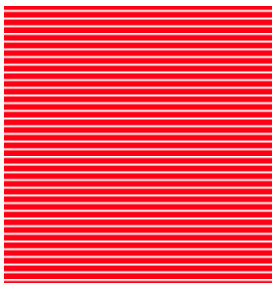
Tutorial Manual



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Additional Document for User's Manual
R0E000080KCE00EP2

Renesas Microcomputer Development Environment System
M16C Family / R8C/Tiny Series
Notes on Connecting the R8C/10, R8C/11, R8C/12, and R8C/13

User's Manual

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Section 3 Pin Assignments of the E8 Connector 5
Section 4 Example of E8 Connection 7
Section 5 Differences between the MCUs and the Emulator 11
Section 6 Applicable Tool Chain and Partner Tools 17

Section 1 Specifications of the E8 Emulator

Table 1.1 shows the specifications of the R8C/10, R8C/11, R8C/12 and R8C/13 Groups E8 Emulator.

Table 1.1 Specifications of the R8C/10, R8C/11, R8C/12 and R8C/13 Groups E8 Emulator

Target MCU	M16C/ Family R8C/Tiny Series R8C/10, R8C/11, R8C/12 and R8C/13 Groups	
Usable MCU mode	Single-chip mode	
Break function	- Address-match break, 2 points - PC break (up to 255 points) - Forcible break	
Trace function	Not available	
Flash memory programming function	Available	
User interface	Clock synchronous serial interface (communicating via P00/P37/CNVss pin) * UART1 function cannot be used in a user program	
Program for the E8 Emulator	ROM size: 2 KB * Varies depending on the device. For detail, see ”Section 5 Differences between the MCUs and the Emulator”.	
Emulator power supply	Unnecessary (USB bus powered, power supplied from the PC)	
Interface with host machine	USB (USB 1.1, full speed) * Also connectable to host computers that support USB 2.0	
Power supply function	Can supply 3.3 V or 5.0 V to the target board (300 mA, max)	
Power voltage	R8C/10, R8C/12	3.0--5.5 V (f(XIN)=16MHz) 2.7--5.5 V (f(XIN)=10MHz)
	R8C/11, R8C/13	3.0--5.5 V (f(XIN)=20MHz) 2.7--5.5 V (f(XIN)=10MHz)

Section 2 Connecting the Emulator with the User System

Before connecting an E8 emulator (hereafter referred to as emulator) with the user system, a connector must be installed in the user system so that a user system interface cable can be connected. When designing the user system, refer to Figure 3.1, Pin Assignments of the E8 Connector, and Figure 4.1, Example of E8 Connection, shown in this manual.
Before designing the user system, be sure to read the E8 emulator user's manual and the hardware manual for related MCUs.

Table 2.1 shows the recommended connector for the emulator.

Table 2.1 Recommended Connector

Type Number	Manufacturer	Specifications
2514-6002	3M Limited	14-pin straight type

Connect pins 2, 4, 6, 10, 12, and 14 of the user system connector to GND firmly on the PCB. These pins are used as electrical GND and to monitor the connection of the user system connector. Note the pin assignments of the user system connector.

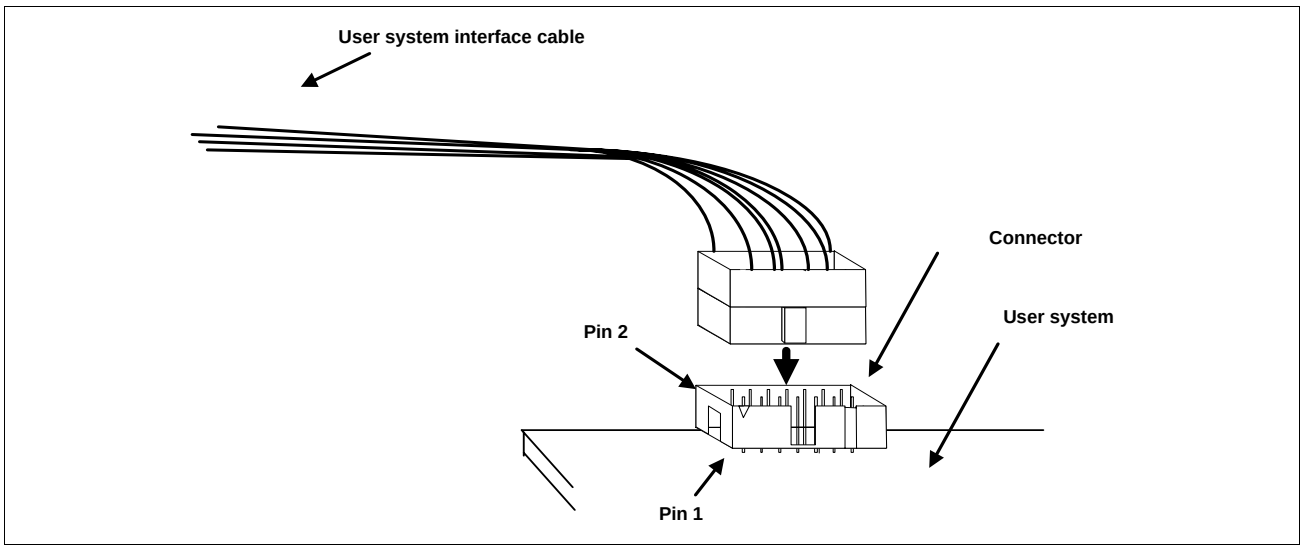
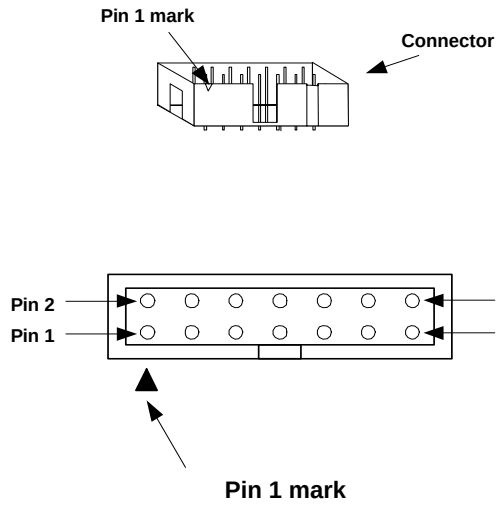


Figure 2.1 Connecting the User System Interface Cable to the User System

Notes: 1. Do not place any components within 3 mm of the connector.
2. When the emulator is used in the writer mode, connect the emulator similarly to the user system.

Section 3 Pin Assignments of the E8 Connector

Figure 3.1 shows the pin assignments of the connector.



Pin NO.	R8C/10, 11, 12, 13 MCU signals
1	**CNVss**
2	Vss
3	N.C.
4	Vss
5	P00/AN7/**TxD11**
6	Vss
7	**MODE**
8	Vcc
9	N.C.
10	Vss
11	P37/TxD10/**RxD1**
12	Vss
13	**$\overline{\text{RESET}}$**
14	Vss

Figure 3.1 Pin Assignments of the E8 Connector

Section 4 Example of E8 Connection

Figure 4.1 shows the connecting example.

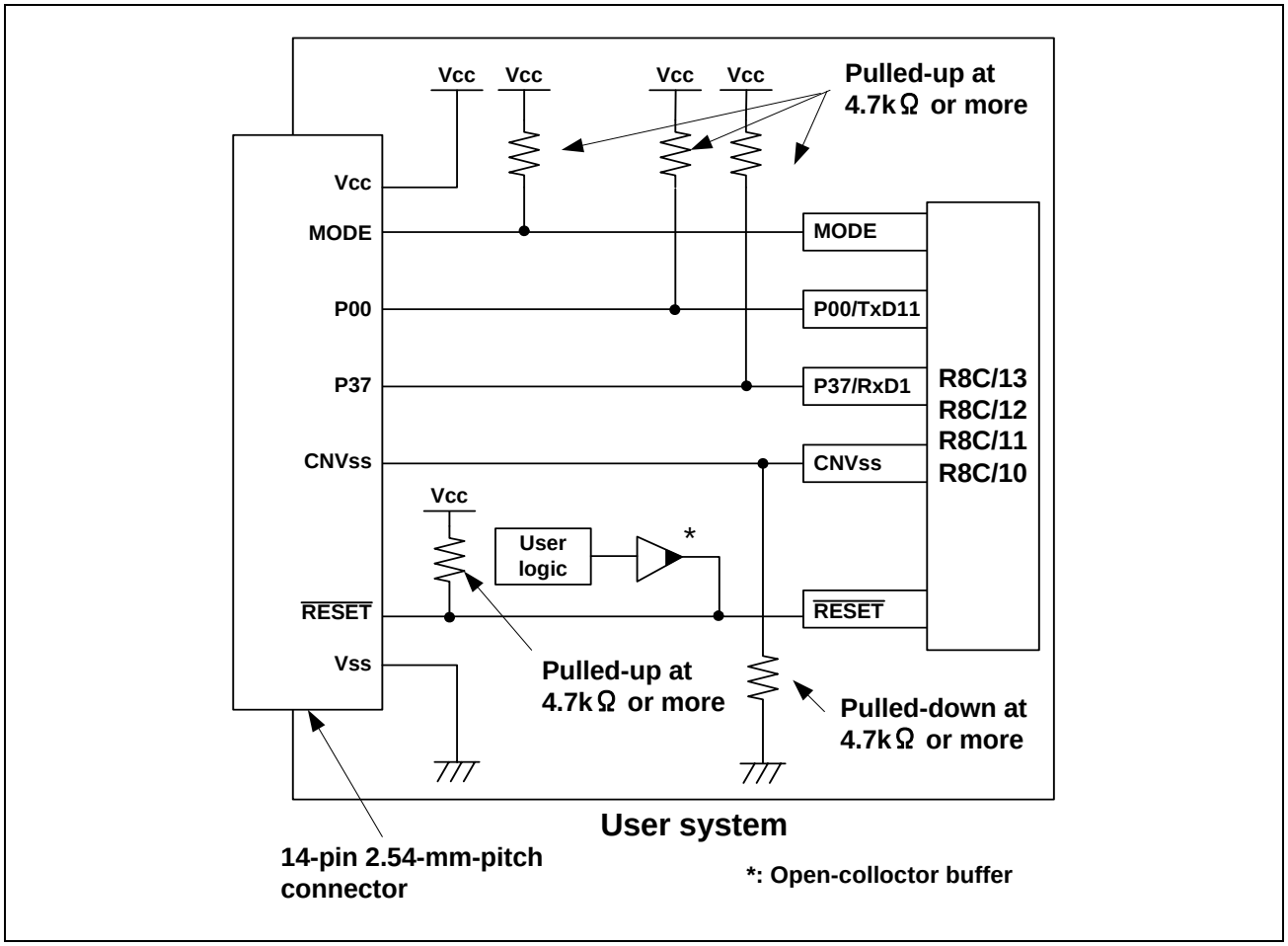


Figure 4.1 Example of E8 Connection

In the ‘Writing Flash memory’ mode, where the user program is simply written to the flash memory, the specification of connection between the E8 and the MCU is the same as that shown in Figure 4.1.

Notes: 1. P00 and P37 pins are used by the E8 emulator. Pull up and connect the emulator and MCU pins.

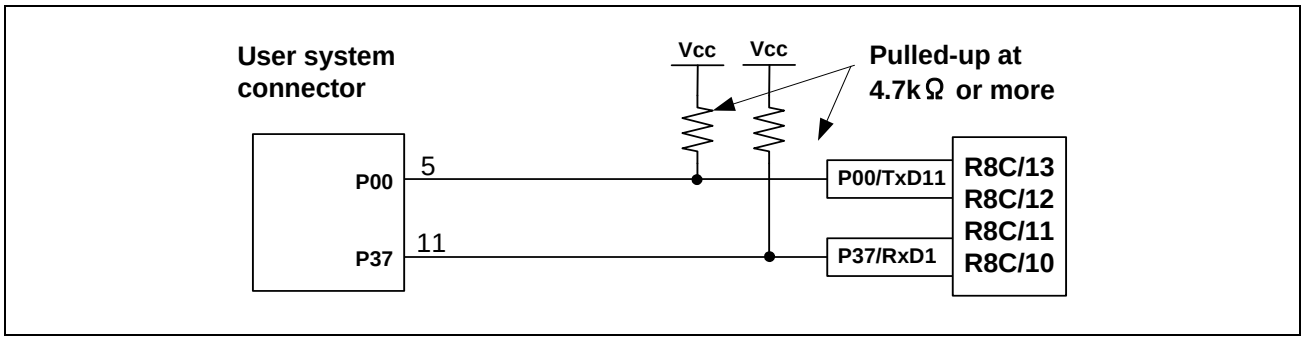


Figure 4.2 Connection of E8 Emulator and MCU

2. The E8 emulator uses the MODE pin for the MCU control and the forced break control. Connect the E8 emulator to the MCU pins through pull-up.

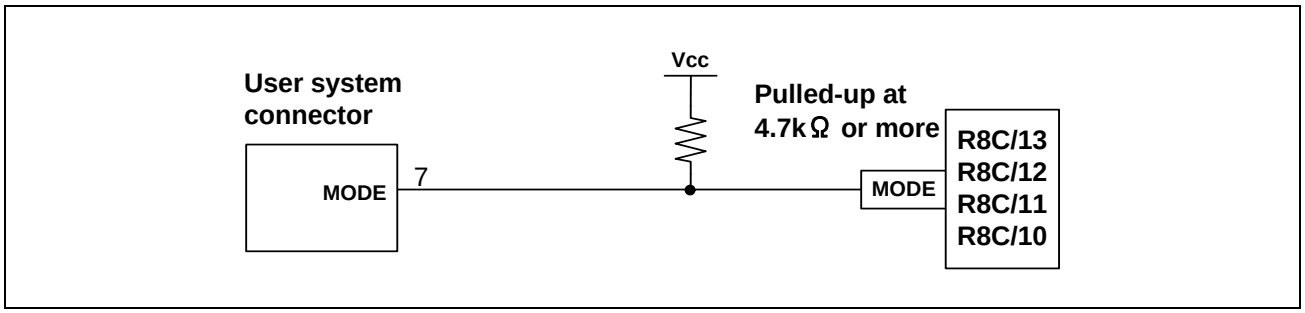


Figure 4.3 Connection of E8 Emulator and MODE Pin

3. The E8 emulator uses the CNVss pin for the MCU control and communication. Connect the E8 emulator to the MCU pins through pull-down.

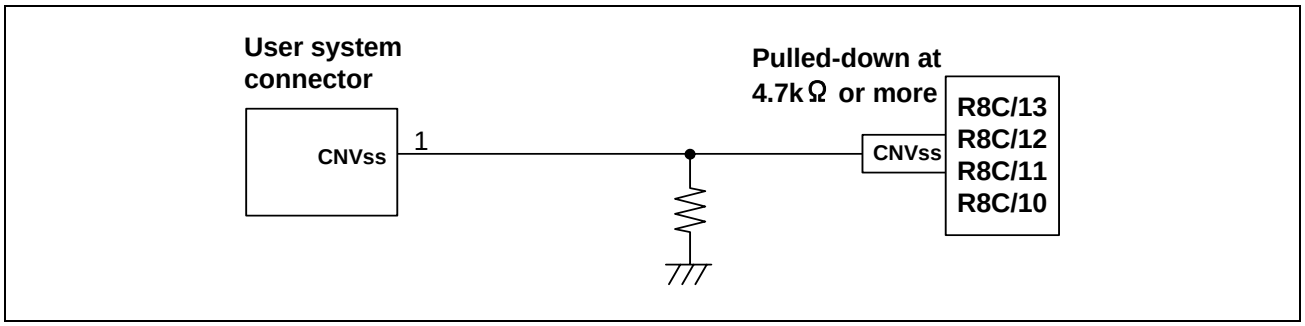


Figure 4.4 Connection of E8 Emulator and CNVss Pin

4. The $\overline{\text{RESET}}$ pin is used by the E8 emulator. Create the following circuit by connecting the open-collector output buffer so that reset input can be accepted from the E8 emulator.

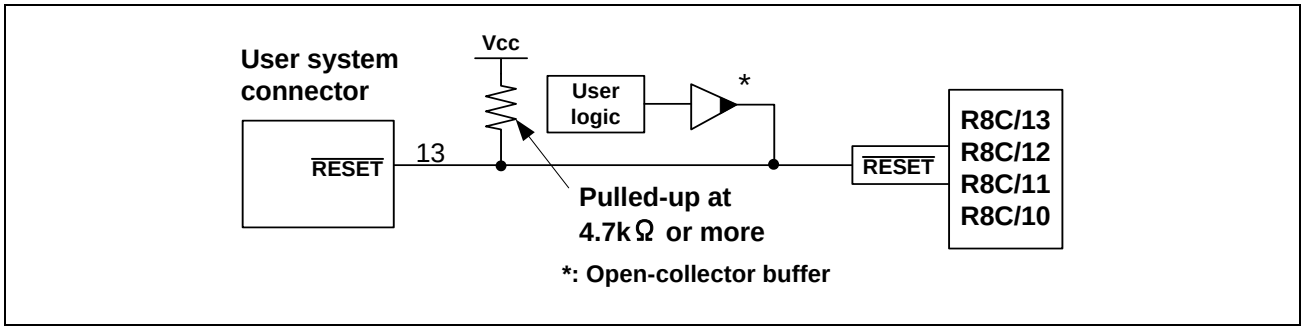


Figure 4.5 Example of a Reset Circuit

5. Connect Vss and Vcc with the Vss and Vcc of the MCU, respectively.
6. Connect nothing with N.C.
7. The amount of voltage permitted to input to Vcc must be within the guaranteed range of the microcomputer.

8. Figure 4.6 shows the interface circuit in the E8 emulator. Use this figure as a reference when determining the pull-up resistance value.

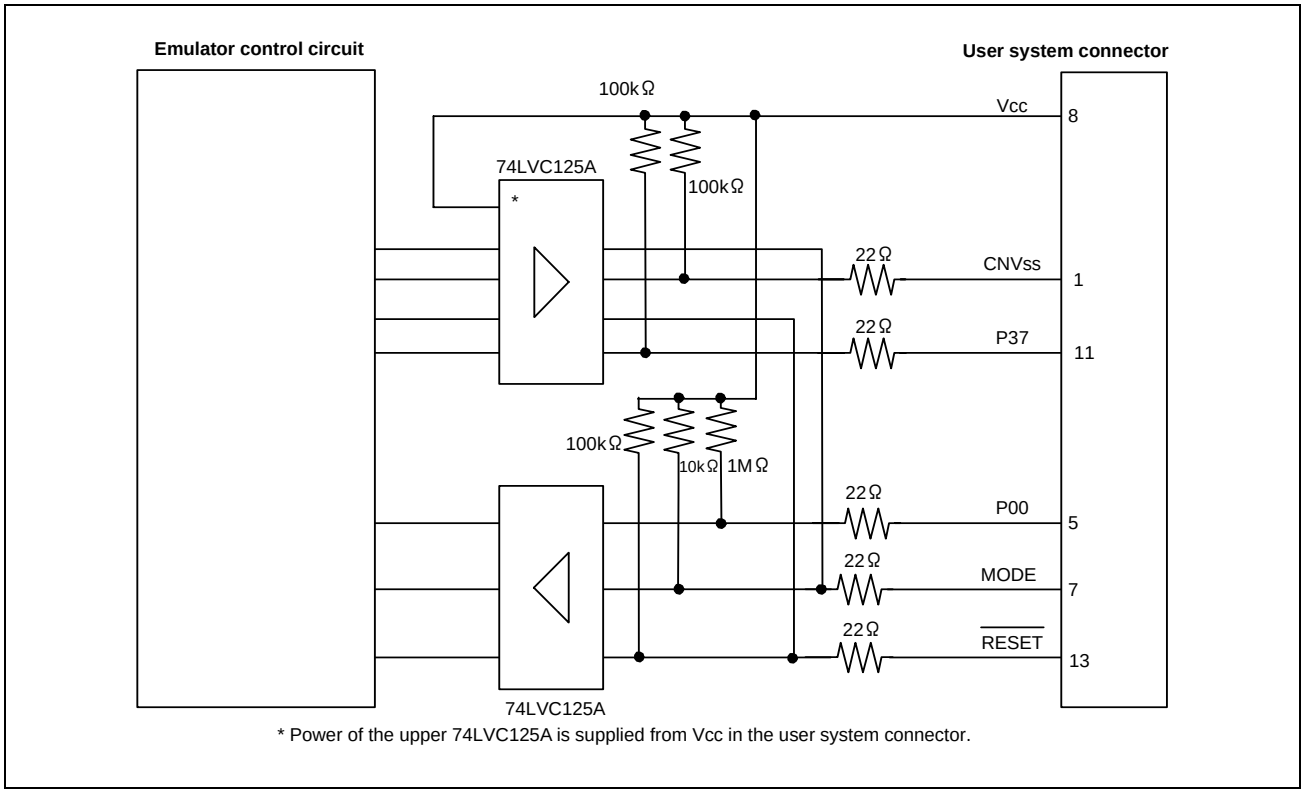


Figure 4.6 Interface Circuit in the Emulator (Reference)

Section 5 Differences between the MCUs and the Emulator

1. Program area for the E8 emulator

   Table 5.1 lists the program area for the E8 emulator.

   Do not change this area, otherwise the E8 emulator will not operate normally. In this case, restart the High-performance Embedded Workshop with the 'Download emulator firmware' mode.

Table 5.1 Program Area for the E8 Emulator

Group	Type Number	ROM Size		Program Area for E8 Emulator	
		Programming Area	Data Area	Vector Area	ROM Area
R8C/10	R5F21102	8 KB	-	FFE4h-FFE7h, FFE8h-FFEBh, FFECh-FFEFh, FFF4h-FFF7h, FFF8h-FFFBh	-
	R5F21103	12 KB	-		-
	R5F21104	16 KB	-		C000h-C7FFh
R8C/11	R5F21112	8 KB	-		-
	R5F21113	12 KB	-		-
	R5F21114	16 KB	-		C000h-C7FFh
R8C/12	R5F21122	8 KB	4 KB		-
	R5F21123	12 KB	4 KB		-
	R5F21124	16 KB	4 KB		2000h-27FFh or [Note] C000h-C7FFh
R8C/13	R5F21132	8 KB	4 KB		-
	R5F21133	12 KB	4 KB		-
	R5F21134	16 KB	4 KB		2000h-27FFh or [Note] C000h-C7FFh

Note: If your MCU is R5F21124 or R5F21134, the dialog box shown in Figure 5.1 is displayed when starting up the High-performance Embedded Workshop. Select the location of a program for the E8 emulator with this dialog box.
The location of the program area is 2000h-27FFh and C000h-C7FFh when selecting 'Data Flash Area' and 'User Flash Area', respectively.
When the High-performance Embedded Workshop is started with the 'Does not download emulator firmware' mode, select the area where the firmware has been written to previously.

Figure 5.1 [Firmware Location] Dialog Box

2. ID code of flash memory

When starting up the High-performance Embedded Workshop in ‘Does not download emulator firmware’ mode, the dialog box shown in Figure 5.2 is displayed. Then input the 7 bytes ID code (Table 5.2) written to the flash memory.

When starting up in ‘Download emulator firmware’ mode or ‘Writing Flash memory’ mode, the flash memory, including ID code, will be initialized to “FFh”. When starting up in ‘Does not download emulator firmware’ mode, the flash memory, including ID code, will not be initialized. When the user program is downloaded, contents of the user program are input as ID code regardless of the mode at startup.

Table 5.2 ID Code Storage Area of R8C/10, 11, 12 and 13

Address	Description
FFDFh	First byte of ID code
FFE3h	Second byte of ID code
FFEBh	Third byte of ID code
FFEFh	Fourth byte of ID code
FFF3h	Fifth byte of ID code
FFF7h	Sixth byte of ID code
FFFBh	Seventh byte of ID code

Figure 5.2 [ID Code] Dialog Box

[Note on Writing in ID code mode]

When the ID code is specified by the -ID option of the lmc30, download the MOT file or HEX file. When the X30 file is downloaded, the ID code is not effective. When downloading the X30 file, specify the ID code using an assembler directive command such as “.BYTE”. The file to which the ID code specified by the assembler directive command “.ID” is output varies depending on the version of the assembler. For details, refer to the user’s manual of the assembler.

3. When the emulator system is initiated, it initializes the general registers and part of the control registers as shown in Table 5.3.

Table 5.3 Register Initial Values at Emulator Power-On

Status	Register	Initial Value
Emulator Power-On	PC	Reset vector value in the vector address table
	R0 to R3 (bank 0, 1)	0000h
	A0, A1 (bank 0, 1)	0000h
	FB (bank 0, 1)	0000h
	INTB	0000h
	USP	0000h
	ISP	05FFh
	SB	0000h
	FLG	0000h

4. Operation clock during a break

   As the emulator is controlled independent of a user's system clock during a user program break, it operates with the internal high-speed on-chip oscillator (approx. 8 MHz).

5. Reset

   To reset the MCU when debugging by the E8 emulator, select [Debug] -> [Reset CPU] or use the RESET command. If the emulator is reset differently, the E8 cannot be controlled.

6. Memory access during emulation execution

   When referring or modifying the memory contents, the user program is temporarily halted. For this reason, realtime emulation cannot be performed.

7. The emulator communicates with the MCUs by using the MODE, $\overline{\text{RESET}}$, P00, P37 and CNVss pins.

8. The power consumed by the MCU increases by several mA or over 10 mA. This is because the user power supply drives one 74LVC125A to make the communication signal level match the user-system power-supply voltage.

9. The emulator uses up to four-word stack pointer when a user program breaks. Accordingly, reserve the four-word addresses for the stack area.

10. When debugging, the flash memory is frequently re-written by the E8 emulator. Therefore, do not use an MCU that has been used for debugging.
    Also, as the program for the E8 emulator is written into the MCU while debugging, do not save the contents of the MCU's flash memory that have been used for debugging or use them as the ROM data for products.

11 SFR used by the program for the E8 emulator

The SFR listed in Table 5.4 is used by the program for the E8 emulator as well as the user program. Do not change the value in the memory window, etc., by other than the user program.

The SFR listed in Table 5.5 is used by the program for the E8 emulator, not user program. Do not change the registers, otherwise the E8 cannot be controlled.

The SFRs listed in Table 5.4 and 5.5 are not initialized by selecting [Debug] -> [Reset CPU] or with the RESET command. If their contents are referred to, a value that has been set in the program for the E8 emulator will be read.

Table 5.4 SFR Used by Program for E8 Emulator (1)

Address	Register	Symbol	Bit
0006h	System clock control register 0	CM0	Bit 6
0007h	System clock control register 1	CM1	Bits 4, 6 and 7
0008h	High-speed on-chip oscillator control register 0	HR0	Bits 0 and 1
000Ah	Protect register	PRCR	Bits 0 and 1
000Bh	High-speed on-chip oscillator control register 1	HR1	All bits
000Ch	Oscillation stop detection register	OCD	Bit 2

Table 5.5 SFR Used by Program for E8 Emulator (2)

Address	Register	Symbol	Bit	Notes on using the E8 emulator
00A8h	UART1 transmit/receive mode register	U1MR	All bits	*1
00A9h	UART1 bit rate register	U1BRG	All bits	*1
00AAh, 00ABh	UART1 transmit buffer register	U1TB	All bits	*1
00ACh	UART1 transmit/receive control register 0	U1C0	All bits	*1
00ADh	UART1 transmit/receive control register 1	U1C1	All bits	*1
00AEh, 00AFh	UART1 receive buffer register	U1RB	All bits	*1
00B0h	UART transmit/receive control register 2	UCON	Bits 1, 5 and 6	*2

*1 Do not change the value of the register.

*2 Do not change the value of the bits listed above. When operating this register, change it by a bit operating instruction, etc.

12. Interrupts used by the E8 emulator program

The BRK instruction interrupt, address match interrupt and single-step interrupt are used by the E8 emulator program. Therefore, make sure the user program does not use these interrupts.

13. Peripherals used by the E8 emulator program

UART1 is used by the E8 emulator. Do not use UART1 by the user program.

14. Reserved area

The addresses not specified in the Hardware Manual for R8C/10, R8C/11, R8C/12 and R8C/13 Groups are reserved area. Do not change the contents. Otherwise, the E8 emulator cannot be controlled.

15. Debugging in the stop mode or wait mode

When using the stop mode or wait mode on a user program, firstly disable the automatic update in the watch window or fix the display in the memory window so that the memory access will not occur during execution. In addition, do not operate the window until the program stops at the breakpoint by setting the breakpoint at the processing unit where the stop mode or wait mode is cancelled.

16. Debugging of a watchdog timer

    During the program for the E8 emulator operation, the watchdog timer is being refreshed. Note that if a memory is accessed via the memory reference or modification, the watchdog timer will be refreshed through the intervention of the program for the E8 emulator.

17. Peripheral I/Os during a break

    During a break, although interrupts are not accepted, peripheral I/Os continue to be operated. For example, a timer interrupt is not accepted although counting a timer is continued when a user program is stopped by a break after operating a timer.

18. Exceptional step operation

a) Software-interrupt instruction

STEP operation cannot be performed by continuously executing the internal processing of instructions (undefined, overflow, BRK, and INT) which generates a software interrupt.

<Example> INT instruction

```
            NOP
            NOP
            INT#3
            NOP          ↘ Passes through if the STEP operation is carried out.
            JMP MAIN
INT_3:
            NOP     ←—— The address at which the program should be stopped.
            NOP
            NOP
            REIT
```

b) INT instruction

Debugging of the program using the INT instruction should be used with the GO command by setting a software break for the internal processing of the INT instruction.

<Example>

```
            NOP
            INT  #3
            NOP                    ↓ Execution with the GO command
            JMP  MAIN
INT_3:
NOP  Break  ←
NOP
REIT
```

19. “Run to cursor” function

The "Run to cursor" function is realized by using an address match break. Therefore, when you execute the "Run to cursor" command, all the address match breaks you set become invalid, while all the PC breaks remain valid.

20. Note on PC break point

When downloading a user program after changing it, the address setting of a PC break may not be corrected normally depending on the changes. After downloading a user program, please check the setting of a PC break by event point window and reset it.

21. Note on debugging in CPU rewrite mode

CPU rewrite mode can be executed only for the data area. If the CPU rewrite mode is executed for the program area, E8 emulator will run out of control.

When rewriting the data area, do not halt the user program after setting the CPU rewrite mode until releasing it. If you do so, the E8 emulator may run out of control. Cancel the automatic renewal in the watch window in advance and select fixing display in the memory window to prevent a memory access from occurring while executing the user program.

To check the data after executing the CPU rewrite mode, halt the program after releasing the CPU rewrite mode and see the memory window etc.

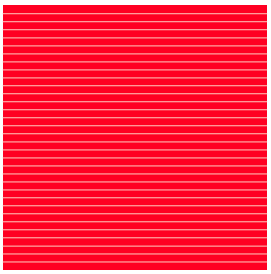
Section 6 Applicable Tool Chain and Partner Tools

With the R8C/Tiny Series E8 emulator, you can debug a module created by the inhouse tool chain and third-party products listed in Table 6.1 below.

Table 6.1 Applicable Tool Chain and Partner Tools

Tool chain	M3T-NC30WA V.5.20 Release 1 or later NC8C V.5.30 Release 1 or later
Partner tools	TASKING M16C C/C++/EC++ Compiler V.2.3r1 or later IAR EWM16C V.2.12 or later

E8 Emulator
Addtional Document for User's Manual



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